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THE PAINLESS DESTRUCTION OF DOGS AND CATS.

THE VETERINARY JOURNAL for September, 1927, was a "Practical Humanity" number, and the time is especially appropriate just now for another issue on similar lines, as a great deal of attention has recently been attracted in the lay press to the subject of the painless destruction of dogs and cats. A well-known member of our profession, Lieut.-Colonel Rainey, late Deputy Director-General of the Royal Army Veterinary Corps, has published a small brochure on the euthanasia of these animals,* which deals with various aspects of the question as they interest the veterinary practitioner and the animal-loving public. It is all the more appropriate at the present time because the numerous animal protection societies have at last recognised that all their methods are not painless, and that even the so-called lethal chamber can inflict a most terrible and painful death upon its occupant. The "doing to death" of all animals is a matter upon which skilled veterinary knowledge is necessary, and in all civilised countries except England the veterinary surgeon is always the first to be consulted. Many methods are equal in their humanity, *but the efficiency of the personal element counts in each and every one, and is really the most important factor.* No one should be placed in a position to deliberately destroy animal life without having been properly instructed, and it is to be hoped that this factor will be emphatically pressed by the committees which have recently been appointed by the National Veterinary Association and the Animal Humane Societies to report upon the matter.

*"Euthanasia of Dogs and Cats." By Wakefield Rainey, C.B.E., M.R.C.V.S. London: Baillière, Tindall & Cox. Pp. 45. Price 1s.

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General Articles

STERILITY IN THE COW: SOME OBSERVATIONS ON CAUSES OF THE CONDITION MOST FREQUENTLY ENCOUNTERED IN THE PRACTICE OF VETERINARY MEDICINE.*

By J. F. D. TUTT, F.R.C.V.S.
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(Concluded from our last issue.)

Differentiation between a Cyst, a Corpus Luteum and a Maturing Ovisac.

In concluding consideration of this part of the subject of sterility, *viz.*, that arising from disease or functional disturbances of the ovaries, it is essential from the clinical standpoint to have some idea of distinguishing between the three " bodies " most likely to be found on rectal palpation. The distinction to be drawn from the symptoms shown between a cyst or " bladder " and a corpus luteum, is that a cyst causes irregularity in the œstral cycle, whereas a corpus luteum prevents its occurrence. On palpation a corpus luteum, as has already been pointed out, is a distinctly hard body. A cyst, on the other hand, is a distinct " bladder," and ruptures on pressure. With regard to the distinction between a maturing ovisac and a cyst, it has to be admitted that this is not such an easy matter. Size alone is nothing very much to go upon, and the only reliable evidence in these cases is the œstral history of the animal under examination. It can be stated that cows with a regular œstrus cycle do not have cysts.

Nielsen[5] is probably correct when he states that the criterion of a cyst is not a definite size, but solely the degenerative processes, which certainly may be assumed with a considerable degree of probability to be present when the bladder has reached a considerable size, but which also, on the other hand, may be present in bladders too small to be palpated per rectum, and one is forced to agree with him when he states that the follicles are inclined to grow to an unusual size about the fifth to sixth week after parturition. It is certain that a good many reputed " cysts " or " bladders " are in reality over-distended maturing ovisacs which for some reason or other have failed to rupture, and although the rupturing of such an ovisac in mistake for a cyst is not harmful, any brutal crushing of the ovary will have disastrous effects on the breeding abilities of the animal. This statement is based on the fact that, judging from clinical records, there would appear to be reasonable grounds for supporting the theory that quite a few of the obscure cases of sterility may be due to a tardy rupture of the ovisac, with

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the result that by the time that the ovum is liberated the spermatozoa have either perished or are so feeble that they can no longer carry out fertilisation. Earlier observers have stated that this rupture of the ovisac occurs towards the end of the "heat," but judging from a number of cows examined in varying stages of œstrus, it is obvious that the ovisac has ruptured, as no maturing ovisac has been found. In summing up, it is as well to include the differentiations laid down by Nielsen[6]:

(1) That the size of the normal follicle may vary considerably (this is proved by the examination of the ovaries of normal cows, in which there is no irregularity of the œstrus cycle and no evidence of disease elsewhere). (2) That the diameter may be considerably larger than 1.5 cm., at any rate 2 to 3 cm. (3) That the limit between follicles and cysts in respect of size is entirely indistinct. (4) That consequently the diagnosis of cystic degeneration cannot be based solely on palpation of the ovaries unless the ovaries concerned, and the bladders contained therein, be of enormous size. (5) That, therefore, generally to fix the diagnosis of cystic degeneration, the outer signs of nymphomania must be clearly present (slack, broad, pelvic ligaments; enlargement of the vulva, projecting high tail root). (6) That, on the other hand, these signs may be found clearly expressed without any ovarial bladders being palpable. (In the *Veterinary Record*, p. 521, 1932) I have pointed out that it is often possible to make a diagnosis of nymphomania several weeks prior to the formation of cysts, by reason of the marked atony of the sacro-tuberous ligaments.) (7) That, consequently, the diagnosis of cystic degeneration is difficult in many cases to fix clinically with any certainty. (8) That when these conditions are not known or considered the diagnosis of cystic degeneration may be applied to cases which are really normal.

According to Albrechtsen, cysts usually appear from fourteen days to one month after parturition or abortion.

Prognosis of Ovarian Diseases.—This depends on the extent of disease elsewhere. When there is marked bilateral salpingitis the chances of recovery are remote, and the same remark applies to adhesions of the ovaries to the pavilion of the oviducts (pavilionitis), long-standing pyometra with a resulting degenerated endometrium, and loss of tone of the uterine walls.

Disease of the Fallopian Tubes: Salpingitis.

Disease of the Fallopian tubes is common in a large number of cows that suffer from permanent sterility.

Ætiology.—Infections of the Fallopian tubes are invariably secondary to extension of infection from the uterus, and are almost always, sooner or later, associated with pathological changes in the ovaries. Salpingitis frequently appears to occur as an extension from inflammation of the uterine mucosa, and there is no question that it often disappears spontaneously. Tuberculosis of the salpinx is not common.

Symptoms.—If the ovary is not involved, œstrus may be regular, but as a rule, as the disease becomes marked, ovarian lesions occur and irregularity follows.

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On rectal examination, when the tubes are normal, it is by no means an easy matter to find and trace them, but this is not surprising when it is remembered that their normal diameter is only an eighth of an inch. Clinical experiences force one to conclude that the finding of an easy palpable tube justifies the diagnosis of salpingitis. In the early stages of the disease rectal examination does not as a rule help very much, but as it progresses palpation per rectum should, and usually does, reveal enlargement. It is obvious from case records that the condition is invariably bilateral, and is usually associated with some other disease of the genital tract, such as an endometritis. It is, indeed, doubtful if it occurs less frequently than pathological ovarian changes, and it is probable that the permanent sterility which often follows the so-called " white heifer " disease (*i.e.*, imperforate hymen) is due to salpingitis as a result of extension of infection from the uterus.

The enlargement of the tubes may be multiple, or it may be diffuse from the uterine cornua to the fimbriated extremities. As a rule this enlargement is firm to the feel, but is compressible on pressure, and fluctuation cannot be detected. In acute cases where occlusion of the ostia occurs early, pus accumulates as a result of the swelling of the mucous folds, and there is no tendency to abscess formation. In some cases encountered, the enlargements have been arranged like a row of beads. The infections involving the Fallopian tubes usually arise from the uterine extremities, but in cases of tuberculosis affecting the peritoneal cavity it is probable that the infection arises from the ovarian extremities. W. L. Williams, in " Diseases of the Genital Organs of the Domestic Animals " (1921), is of the opinion that tubal disease is very frequently associated with cystic degeneration of the corpus luteum as a result of infection of the ovarian crater after ovulation.

Prognosis.—This is distinctly unfavourable, except in those cases where the condition is unilateral. As in time, however, the condition invariably becomes bilateral, treatment is often not worth the trouble unless the cow is a valuable one. In cases of " beaded " salpingitis the animal should be fattened off and disposed of. Cases of chronic hydrosalpinx and pyosalpinx are incurable, owing to the irreparable pathological changes which have taken place in the mucosa.

Treatment.—This is expectant. Ovarian cysts when present are to be dispersed; endometritis treated according to its intensity. On twelve selected cases of salpingitis treatment with Oppermann's Yatren Sterility Vaccine, in conjunction with Yatren as an intra-uterine injection, was carried out. In one case only did recovery result. In the case of the human female, the patency of the tubes can be tested either by means of Rubin's carbon dioxide gas method, or by injections of lipiodol (and X-ray). Resulting fertility has been stated to occur following the use of these methods, intended primarily for diagnostic and not curative purposes.

Diseases of the Uterus.

Inflammation of the chronic type of the mucous membrane of the uterus is by far the commonest lesion met with in cows suffering from sterility, and to which the name of endometritis has been given. Under this heading will

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be described the various results of inflammation affecting the uterus. Their clinical importance is considerable and their pathology is often debatable. The true inflammatory changes, namely, those in which there is histological evidence of inflammation, are probably due in the first instance to infection ; nevertheless, it is not always possible to determine the nature of the infective agent. It will be understood that an inflammatory process attacking the endometrium will tend to spread by continuity of tissue to the uterine muscle, and therefore in any case of infective endometritis an element of metritis may also exist. Experience shows that except in cases of acute infection, the muscular tissue is not extensively invaded, and the changes in the endometrium form the important feature. In some cases of chronic infection, however, the whole muscular wall may become infected, giving rise to one variety of the condition known as chronic metritis. In the case of sterility, it is the chronic forms of endometritis which have to be dealt with. So far as the chronic form is concerned, it was originally divided for purposes of description into two main classes :

(1) *Chronic Corporeal (Interstitial) Endometritis.*—In these cases the stress of the changes falls upon the stroma, but in some types glandular increase is also present. Accordingly the main inflammatory changes in all cases are interstitial, and the name " interstitial endometritis " adequately describes them all.

(2) *Chronic Cervical Endometritis.*—This is somewhat loosely referred to in veterinary text-books as " cervicitis," in which the inflammatory changes are regarded as confined to the cervix. For practical purposes the best classification of the various types of endometritis that are encountered in bovine sterility is that adopted by Nielsen :

(*a*) *Endometritis Puerperalis.*—This included all pronounced inflammatory processes in the uterus within the first three weeks after parturition, *i.e.*, within the period during which involution should normally be finished.

(*b*) *Endometritis of the First Degree (Chronic Catarrhal Endometritis).*—A light inflammation of the uterus not accompanied by any, or at any rate only a very slight, enlargement of the uterus, and not by any conspicuous flow.

(*c*) *Endometritis of the Second Degree (Muco-purulent or Purulent Metritis).*—This form corresponds to the old denomination of " fluor albus " of various intensities.

(*d*) *Endometritis of the Third Degree (Pyometra).*—Nielsen points out that in accordance with his definition of endometritis puerperalis, pyometra includes only cases of certain accumulation of exudate in the uterus when this state is found later than three weeks after the preceding birth.

(*e*) *Endometritis of the Fourth Degree (Chronic Endometritis with Cystic Degeneration of the Ovaries).*—This group comprises all cases of cystic ovarian degeneration.

Ætiology.—The condition of endometritis has been observed in heifers, even in virgin heifers, and the cause of the varying degrees of endometritis is infection. One cannot subscribe to the view that endometritis is a result and not an actual early cause of sterility, with one possible exception, and that is in cases of nympho-

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mania. Larger cows are more susceptible to chronic endometritis owing to the longer period of the involution of the uterus. Infection of the uterus during parturition is apt to occur when assistance is rendered by an attendant not too conversant with the first principles of asepsis, and when parturition, whether requiring assistance or not, takes place under unhygienic conditions. Delayed involution of the uterus after parturition favours infection, and the *Br. abortus Bang*, by weakening the mucous membrane, predisposes the uterus to infection. Excluding an infective agent as a cause of this delayed involution, it may be recollected that the removal of the calf at birth from its parent has been regarded as a possible cause of delayed uterine involution. A natural, healthy, full-term parturition is characterised by the easy birth of the calf, and expulsion of the placental membranes either with the calf, or practically immediately afterwards, and certainly within a few hours. Any abnormal retention of these membranes, even in cases where parturition is normal, is a clear indication that all is not well within the uterus. The importance of hastening their expulsion, and so assisting uterine involution and the maintenance of the uterus in as aseptic a state as possible during this period, cannot be too strongly emphasised.

Symptoms.—It will be apparent from the classification of endometritis that the symptoms exhibited will depend upon the nature and the severity of the attack, and the degree of the intensity may vary from a simple catarrh to a purulent inflammation. In cases of endometritis of the first degree the uterine enlargement is very slight, and the discharge, which is of an opalescent mucous nature, with flocculi, is not very conspicuous, and it is often necessary to retract and massage the cervix to detect the discharge. Except in these mild cases, the uterine cornua are asymmetrical, the cervical canal is dilated, and in extreme cases will admit the finger. Œstrus and ovulation are usually regular. In cases of endometritis of the second degree manipulation *per rectum* will reveal an enlarged uterus, and *per vaginam* the os uteri externum is larger than normal. There is an abundant supply of mucous discharge with small flocculi, or pus alone. In cases of endometritis of the third degree examination *per rectum* will reveal an enlarged uterus, and the cornua are thickened and may be from 10 to 15 cm. wide, and it will probably be impossible to feel the large anterior curvature. On vaginal examination the os will often be found dilated and there may be a discharge of a purulent nature. On the other hand, the os may be closed, or only partially open, with resulting slight intermittent discharge. Such cases on rectal examination may be mistaken for those of pregnancy, but this error should not arise, as, in addition to other signs, a pregnant uterus is distinctly firm and has a " living " feel, while a uterus affected with pyometra is flabby. In cases of long standing emaciation is common, and cows so affected are apt to be regarded as suffering from tuberculous emaciation, until a rectal examination reveals the real nature of the condition. Contagious abortion and placental retention are the chief causes of pyometra. In cases of endometritis of the second and third degrees œstrus may be shown at long irregular intervals, or it may be absent ;

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but quite a few cases have been met with in which œstrus is shown at varying intervals, and yet the uterus has been found full of decomposing material.

In cases of endometritis of the fourth degree cystic degeneration of the ovaries, with resulting irregularities in the œstral rhythm, is a constant feature, *i.e.*, an unhealthy abnormal heat. *Per rectum* the uterus is found to be not appreciably enlarged, but it has lost its tone and irritability, and as a rule projects beyond the pelvic girdle. The uterine cornua are soft and straight, and do not contract on palpation. Cysts are present in the ovaries. *Per vaginam*, the discharge present may resemble that found in endometritis of the first, second and third degrees. This fourth degree of endometritis is usually the result of contagious abortion. In mild degrees of endometritis the uterine changes referred to may be quite easily overlooked if the examination is made during œstrus, and similarly at this time a normal œstral engorgement may quite readily be regarded as an abnormal endometritic one. The alteration in the symmetry of the uterine cornua will depend entirely on the severity of the attack, and it has been proved that a degree of endometritis may be present which can only be demonstrated on post-mortem, and only then by microscopical means. Sterility arising from endometritis is due to two causes: (1) The discharge which is inimical to the spermatozoa. (2) The unhealthy endometrium which, although conception may take place, offers no favourable focus for the embedding of the ovum. Conception is impossible in endometritis of the third and fourth degrees. Preclusion of conception is not purely mechanical in cases coming under the first and second degrees, but is probably due to the decomposition of protein products which destroy the spermatozoa. It has been found that the first degree is responsible for 66 per cent. of sterility; the second, 20 per cent.; the third, 6.6 per cent.; and the fourth, 7.3 per cent.

Treatment.—This will naturally be guided to a large extent by the degree of endometritis present. The line of treatment that has been most in favour during the past few years, and which has been attended with the most consistent results, is that recommended by Nielsen. No credit is claimed in stating that on the whole this line of treatment has been generally, if not specifically, carried out during the past twenty years. As early as 1912, when occlusion of the os uteri externum was regarded as the prime and probably the only cause of bovine sterility, and when the " cult," to which the term of " womb openers " has since been sarcastically applied, ruled the sterility field, the injection of a small quantity of iodine was carried out after completing dilatation. The beneficial action of the iodine on the endometritic uterus was not then generally recognised, and its use was advocated on antiseptic grounds and by reason of the fact that chinosol, then much in vogue, had the drawback of damaging the plate of the instruments used. Nielsen's treatment can be briefly summarised as follows:

It consists in the injection into the uterus of an iodine solution which is left in the uterus. Its effect is probably due to its irritant action on the endometrium, with a consequent hastening of uterine involution. In cases of the lightest degree

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of endometritis, 150 to 200 c.c. of Lugol's solution, containing 1 per cent. of iodine, are injected. One single injection of this kind will in many cases (about 50 per cent.) effect a cure. In the remaining cases two or three injections are required, and are performed at rather long intervals (a month or more), because it is generally recognised that it is desirable in the lightest degrees of endometritis to await the efficacy, if any, of the single treatment, *i.e.*, to allow the cow to be served.

In the more severe degrees of chronic endometritis—" white flow " (Fluor albus)—endometritis with cystic degeneration of the ovaries, and especially in cases of pyometra, the treatment has usually consisted in the injection of iodine tincture containing 5 per cent. iodine. In the two first-mentioned forms, only 20 to 25 c.c. of iodine are injected into each uterine horn ; in pyometra, on the contrary, larger quantities (from 50 to 100 c.c.) are injected into each horn (the uterine tube being checked as to its progress *per rectum*) depending on the quantity of exudate accumulated. In these more severe degrees of chronic endometritis the cows should not be served after one injection, but the treatment should be repeated at intervals of one or more weeks, depending on the given circumstances, the treatment being modified into the above-mentioned injection of a watery solution of iodine when the endometritis has been partly cured. Equally good, or may be better, results than these, according to Nielsen, may be attained by using a watery solution of iodine with iodide of potassium, merely varying the iodine concentration according to the degree of endometritis. The cows will always strain after such iodine treatment, but considerably more after treatment with iodine tincture, than after the weak watery solution, as will readily be imagined. This straining, however, is of no importance.

Nielsen considers that this line of treatment yields a higher percentage of cures than any other, a view which will be endorsed by all those conversant with bovine sterility as met with in general veterinary practice. On the percentage of cures annually recorded, the iodine treatment has proved the most successful, not only in cases of endometritis in the cow, but also in the mare, in which animal uterine disease is the chief cause of sterility. It is in those cases which come under the second and third degrees that modifications or adjuncts have at times been necessary. In cases that can be classed under the second degree, it has been found advisable to carry out a preliminary flushing-out with normal saline solution. In those that come under the third degree the contents are evacuated, and the uterus flushed out either with normal saline solution or a weak solution of sodium carbonate, and more recently this has been followed with a 3 per cent. solution of colloidal magnesium hydroxide, postponing the iodine treatment until the discharge has appreciably lessened. Rivanol (Bayer) in strength of 1 : 1,000 has been found to be the best when the exudate is of a purulent nature, as it seems to give more rapid and resulting effects than the iodine. It has not been found that squeezing out any persisting corpus luteum is of much benefit, and in fact such a procedure has in most cases been found to be quite unnecessary, as when the pyometra has subsided the corpus luteum has either disappeared

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or become so far absorbed that it has no longer inhibited œstrus, which has become manifested, and acted as a final cleansing agent. On the other hand, it has to be admitted that in some cases of a mild degree of endometritis ovarian massage with the rupture of any cysts present, or expression of corpora lutea, has effected recovery, and this without any uterine treatment. There are, indeed, several sterility workers who adopt this procedure on each and every case, and claim a percentage of cures, which, however, in many cases will not bear close scrutiny. In comparing the two methods, one is forced to state that the percentage of recoveries will be practically doubled if careful uterine injection is carried out, even in mild degrees of endometritis. As an illustration, it may be stated that ovarian and uterine massage without any injection was tried on seventeen selected cases two years ago, and recovery resulted in two cases only. Uterine injection was then applied to the remaining fifteen, and of these thirteen recovered. Of the two failures, one was a pronounced nymphomaniac and a reactor to the tuberculin test, and the other had bilateral salpingitis associated with pyometra. The golden road to success in treating sterility is to treat each case on its merits, and to vary the treatment if no marked improvement follows.

Cervicitis.

This condition, although chiefly met with in the cow, is a fairly common and often overlooked cause of sterility in heifers, and is usually associated with a certain degree of endometritis ; but cervicitis can and does occur independently.

Ætiology.—This condition is frequently the result of an extension of endometritis, and is associated with abortion and retention of the placental membranes.

Symptoms.—On examination *per vaginam*, the cervix is found to be very much inflamed, as evidenced by swelling and redness, and as a rule it will be noticed that one or more folds of the annular mucous membrane lining the cervical canal protrude through the external os like the tongue of a boot. An alteration occurs in the cervical secretion. Normally this is alkaline in reaction, with a tendency that has been compared to the white of an egg ; but in cases of cervicitis not only is the consistency altered, but its chemical reaction becomes acid, with the result that the spermatozoa are either destroyed or are unable to pass on into the uterus. The condition is not an absolute bar to pregnancy, but there is a risk of early abortion and death of the fœtus through the imperfect physiological sealing of the canal.

Treatment.—In view of the fact that endometritis is usually present, this should receive attention, and in mild cases of cervicitis it will be found that as this subsides the condition existing in the cervix will gradually return to normal. In the case of a pregnant cow, uterine treatment is out of the question, and here the cervix must be carefully painted over with weak tincture of iodine, or Lugol's solution. In some such cases treatment is best left alone until after parturition or abortion occurs, as it has frequently been noticed that even in cows with a marked degree of cervicitis and that are pregnant, recovery takes place and their calves carried to full term.

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Diseases of the Vagina and Vulva.

Nodular Venereal Disease.—This is known as contagious or infectious vaginitis —granular vaginitis.

Ætiology.—So far as I am aware, the cause of the disease is not known. It has been observed that where there are many cases of the disease in a herd, the degree of abortions due to the *Br. abortus Bang* is high. In some cases there would appear to be a definite connection between the two, but this has not yet been satisfactorily established.

Symptoms.—On parting the vulvar lips it is noticed that the exposed surface is covered with small elevations or nodules, which in marked cases can be best described as a rash. These may be more or less evenly distributed, or clumped together, the floor of the vagina being free, whilst the roof is studded with them. A muco-purulent discharge, which causes the hair round the bottom of the vulva to stick together, may or may not be present. The colour of the nodules may be faintly pink, or a bright strawberry-red, and the area around them may be reddened and swollen. When the condition is acute the affected cows may show signs of uneasiness by swishing the tail when urine is passed. Service may be resented, and if carried out the semen may be immediately expelled. The disease would appear from clinical observations to have periods of rest and of activity, and in some of the most pronounced cases the affected animal is often well advanced in pregnancy ; in fact in some cases pregnancy would appear to cause the lesions to become more pronounced. It appears to decline with age. The vaginal mucosa of the young bovine has a salmon-pink colour, but as age advances this gradually assumes a dirty yellowish-white or almost icteric tinge. The disease has been observed in heifer calves as young as six months, and whereas the bull can transmit the disease from one cow to another, and contract it himself, it is obvious that his agency is neither essential, nor common.

Its Bearing on Sterility.—The significance of this disease as a cause of sterility is a matter on which professional opinion of international reputation is sharply divided. Nielsen considers that it is possibly the most frequent cause of the failure of heifers to conceive in spite of repeated services ; this view is supported by findings in this district. Albrechtsen declined to regard it as of any importance. Hess, Zschokke and Knell support Nielsen. Richter supports Albrechtsen. The generally-accepted view is that it is a common cause of sterility in heifers, but is not of much importance in older cows. In slight cases it is feasible to assume that by itself it is not responsible for sterility, but clinical experiences force one to conclude that in some herds it may be a most fertile source of delayed conception.

Treatment.—Douching with various agents such as formalin and mercurial preparations has been recommended ; also pessaries and various ointments. Not one of these methods has proved of much practical value, and it has been found that a dusting powder containing either carbolic or iodoform, and applied by means of a powder blower to the affected areas (the vulvar lips being held

apart by an assistant) has yielded the best results. In those cases when the lesions extend too far forward to permit of this treatment, Protargol sticks (Bayer) can be inserted. One is inclined to be sceptical as to a permanent cure, but usually it will be found that the disease can be so reduced in intensity as to permit of successful service and conception.

Amongst other causes of sterility may be mentioned: Cysts in connection with Bartholin's glands and Gaertner's ducts, ruptures of the dorsal wall of the vagina occurring during parturition or service, congenital hypoplasia of the genital tract (as in the so-called "free martin"), and imperforate hymen (as met with in the so-called "white heifer disease"). Leucorrhœa and vaginal discharges in general must be regarded as symptoms of disease rather than diseases in themselves, and their cause must be investigated and rectified when possible.

The Relationship between Contagious Abortion and Sterility.

The increase of contagious abortion in herds in some districts is often accompanied by a high sterility-rate, and it is by no means uncommon to find that, following the use of living abortion vaccine to immunise previously fertile cattle against the disease, it is extremely difficult, and in some cases impossible, to secure conception. The cause in these cases is probably due to the uterine catarrh produced as in a naturally occurring case, and there are many members of the veterinary profession who for this reason will not employ a living vaccine (the use of which must at all times be tempered with caution) for protective purposes on infected premises. Conversely, there are others who deny that its use is followed by sterility. Both are correct up to a certain point, but it is impossible to state exactly how often sterility does or does not follow the use of a living vaccine or a natural attack of the disease. Generally speaking, it has been found that when the disease breaks out suddenly and violently, sterility does not follow at once, but increases during the following years. A great deal would appear to depend on whether or not the placental membranes are expelled at or soon after the abortion, as when this occurs involution of the uterus takes place and normality is reached. This expulsion depends, in my opinion, on the extent to which the disease has attacked the uterine wall. Under normal conditions it is supposed that this expulsion is brought about by two factors: (1) a contraction of the uterus, which cuts off the circulation of blood to the placenta and causes a rapid diminution in the size of the area of its implantation; (2) the relieving of the positive pressure that existed within the uterus prior to calving.

In cases that clear up rapidly, no irregularity as regards œstrus is noticed, but should service be delayed it has been observed that œstrus tends to become either irregular or inordinately prolonged, *i.e.*, absent for a considerable time, and that in conjunction with this, ovarian lesions (cysts) make their appearance. On the other hand, some years ago, in one herd before contagious abortion became established and advice was sought, the owner stated, after vaccination had been carried out for some time, that he did not know what the live vaccine would do to control abortion, but that it was the finest preparation that he knew for "settling

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cows," as every vaccinated animal had conceived, whereas twelve months before they had constantly returned to the bull. This lent considerable colour and proof to the opinion (then held by the late Sir Stewart Stockman) that there was a type of infective sterility, apart from abortion results, that ran its course like that disease, and from which by " passage " there arose an immunity. Thus in the herd referred to it had presumably died down when vaccination was started, and this got the credit in the owner's view, on the usual erroneous assumption, *post hoc ergo propter hoc*. In those cases of sterility of local origin such as are encountered in herds in which contagious abortion is widespread, it seems that *Br. abortus Bang* does not produce the chronic metritis associated with the sterility, but the delayed involution of the uterus affected with it favours the invasion by secondary organisms, which keep up the inflammation after the former organism can no longer be found in the uterus. Williams, in " Diseases of the Genital Organs of the Domestic Animals," considers that abortion and sterility cannot be separated ætiologically from one another. According to him, they are not different diseases, but both result from an endometritis. Any infection of the uterus, according to Williams, can lead to abortion, whether this is due to the *Br. abortus Bang*, or other bacteria.

Williams' view is correct only in so far as one is inclined to attribute more to *Br. abortus Bang* than is really due to it. It cannot be denied that in many cases *Br. abortus Bang* is found in the placental membranes and in the fœtus after abortion, and that abortion can be artificially induced by this organism. It is not a proof that he is correct if this experiment occasionally fails. Williams' view is correct in so far as he advocates that the inflammation of the uterine mucosa—not the abortion—has to be combated. Williams further states that much is attributed to sterility that should really be looked upon as due to abortion, for example, the prevention of the formation of ova or spermatozoa through infection ; the destruction of the fertilised ovum or of the fœtus in the earlier stages of pregnancy. He is probably not incorrect in stating that abortion is considered to be the most frequent cause in the fifth to seventh month of pregnancy, because it is then noticed most. Before this period it is very frequently overlooked, and after the seventh month it is treated as premature or still-birth. Moreover, there are many instances in general practice where the calf, infected in the uterus, dies soon after birth. It is the generally accepted view that the *Br. abortus Bang* disappears from the discharge of an infected cow within two months of the act of abortion.

The disease of calves known as " white scour " has been attributed to intra-uterine infection, and its occurrence has been cited as an example of the hereditary nature of sterility. It is difficult to believe that such an infection would permit the calf to live until it was born and then promptly kill it, and further, it is not feasible that so virulent an organism as that responsible for white scour could maintain itself for any length of time in the uterus without setting up a definite metritis.

In contagious abortion the infection is not an acute or a fatal one, and the organism is not one which invades the bloodstream. It gains access to the stomach of the fœtus from the fluids within the fœtal membranes. Further, the transmission of antibodies to the fœtus differs from the transmission of organisms, because the former are not, so far as we know, particulate, and are capable of diffusion in the ordinary way. As to the available evidence that vaccination with living cultures of the *Br. abortus Bang* causes sterility, it has to be admitted that this is rather contradictory. In one herd of over four hundred head where this has been carried out during the past four to five years, only six cases of sterility have been encountered, and there is not sufficient evidence to connect the two. In another case where twenty cattle were so inoculated, sixteen failed to conceive, although previously they had been fertile. There would, however, appear to be reasonable grounds for stating that there is a risk (but how great it is impossible to define) in using the living vaccine.

A recent view is that abortion and sterility have nothing to do with one another; that abortion is a specific infection, and sterility a non-specific infection of the genital organs. Both the ætiology and the treatment are somewhat different. It appears, however, that the latest views are developing on other lines. It is thought that the chief rôle is played, not by the bacteria, but by other more immediate factors. The factors which under certain conditions lead to increased susceptibility to the disease are to a great extent the same for abortion as for sterility. Thus it is believed that the two problems will be considered together more and more in future.

The Influence of Feeding on Sterility.

The great increase of sterility in cattle in this and in other countries, excluding those causes which are directly due to disease, can be attributed in no small measure to deficiency in the diet—lack of essential minerals and vitamins, combined with excessive milking. The modern cow is apt to be looked upon more as a milking machine than as a reproductive agent, and the advent of milk recording is, in a measure, a mixed blessing.

The earlier reports of Per Tuff, Emmerich, and others, which were well summarised in a paper by Pugh (*Veterinary Record*, pp. 87–91, 1924) have been confirmed by later observations made by Quinlan, Du Toit and Bisschop, working on the same subject in South Africa. There would appear to be but little doubt that the mineral salts, more especially calcium and phosphorus, are necessary for the proper functioning of the reproductive organs. Pugh, in the paper referred to, has stated that there is more sterility on clay soils than on chalk or limestone, where calcium and phosphorus are abundant. This view is not generally accepted, although there is no doubt but that the varying nature of the subsoil has a predominating effect in these cases, and this observer quotes an instance where the effect of removal of a herd on to a more favourable subsoil was most dramatic.

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In parts of the New Forest when œstrus is delayed, not only in cattle, but in mares, it has been found that this is often rectified when the affected animals are turned out where the soil is rich and nutritious.

In regard to the combating of diseases affecting reproduction, especially sterility and abortion, it appears more and more necessary to free oneself from the organo-pathological and the cellular-pathological ideas which have ruled up to the present in medicine. The body is now regarded as an indivisible homogenous whole, and it is acknowledged that the various factors which influence the body from without must be important for the whole organism, and therefore of great consequence for the genesis and course of a disease. The factors which play the chief rôle are food, maintenance and nursing. Increased attention is now being given to the relation between these factors and the occurrence and prevention of reproductive defects. Even if our scientific knowledge on the subject of the investigation of the immediate causes of disease is of recent date, it must be acknowledged that very much has already been accomplished in this direction. The influence of nutrition in particular has received close attention, especially in America. It has often been assumed in the past that nutrition has some influence on sterility and abortion. Both over-feeding and under-feeding have been blamed, and the latest investigations support this assumption.

Perhaps the most important of the recent contributions on this subject is that published in the *Berliner Tierarzliche Wochenschrift*, Vol. XXXXVI, No. 45, pp. 853–6, by Dr. Euler, of the Institute for Veterinary Hygiene of Landsberg. In the course of his article dealing with " Sterility and Abortion as met with in the Posen-West Prussian Frontier Farms and the Eastern Part of Neumark," Dr. Euler reviews the work of Gminder, Stockklausner, Eckles, and others, and describes hunger sterility and a disease known as " Wendener disease," after the name of the place where it was first seen, in which the affected animals aborted or gave birth to weakly calves, and did not conceive again. The administration of cod-liver oil, improving the soil, and liming, gave very good results.

From his article it is obvious that veterinary surgeons must devote far more attention than in the past to the science and technique of feeding. It may be stated that by improper feeding the breeder produces a champion at the expense of her fertility ; consequently, the best females are frequently lost to the breeder. Although the modern varied diet sheets are problems often best left to the specialist in nutrition, it is a fairly safe rule to go by that the protein content should not exceed 15 per cent. of the diet given. Treacled foods are good, but excess must be avoided. As the result of experiments in this connection, the Hampshire County Council Farm Institute at Sparsholt, near Winchester, have adopted the following diet sheet in their Shorthorn dairy herd, which has given excellent results both as regards the milk yield and fertility : one part of earth nut, two parts of rice meal, two parts of crushed oats, two parts of palm kernel, two parts of maize glutein, one part of bran. Of this mixture, when made up in the proportions given, each cow receives three and a-half pounds per gallon

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of milk yield per diem, and in addition receives a daily ration of four pounds of sugar beet pulp and sixteen pounds of hay.

The importance of a properly balanced ration containing a sufficiency of vitamins A, B, C and D, and the fertility vitamin E, cannot be too strongly emphasised if a satisfactory degree of fertility is to be maintained in our best herds.

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LAVAGE AND GAVAGE IN DOG AND CAT PRACTICE.

By J. GILBERT HORNING, D.V.M.

Houston, Texas.

A Brief History of the Stomach Tube.

THE writer is fully cognisant of the fact that lavage of the stomach, and gavage by introduction of a hollow tube, may have been practised by primitive people for their own relief as well as that of their animals from time immemorial. In the history of medicine much data has been published about the invention of the stomach tube and its practical employment in both veterinary and human medicine to relieve the sick. Assembling all published records at hand, it will be my endeavour to present this data in chronological order.

Alexander Monro, of Edinburgh, editor of the "Comparative Anatomy" of 1744, is without doubt the first to employ lavage and gavage in a practical measure with the stomach tube he invented and used on cattle in 1763 (Monro: "De Dysphagia," Edinburgh, 1797). The tube he used had for its tip a brazen pipe two inches long, the same size as the tube, pierced with a number of holes. The tube itself was made of an iron wire, one-tenth of an inch in diameter, that had been twisted around an iron rod to make it cylindrical in form, and the full length was possibly over six feet. It was made smooth by a covering of soft leather, and the stilette consisted of an iron wire. He used a mouth speculum made with boards, the upper and lower plates being one foot in length and three inches wide, and the screws separating the plates being six inches in length. Attached to the upper end of the tube was a bellows with a valve at its muzzle, and one at the side to allow the gas to escape, and by pumping the bellows, suction could be created to remove fluid and gases from the rumen, and insert medicine or liquid nourishment. This tube was used extensively in the treatment of bloat in cattle, and is mentioned in the "Complete Cow-Doctor, or Farmer's Companion," a book treating on common disorders of cattle, their causes, symptoms and cures, written by one Joseph Rowlin, of Cumberland. The first edition was published in London in 1792, the second edition in 1799, and the third in 1804. The editor was R. Walker, of Macclesfield. He describes Dr. Monro's

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tube as being used in yew poisoning and tympanitis. This was also mentioned in the " History of Veterinary Literature," Vol. II, pages 902–912, by the late Major-General Sir Frederick Smith, K.C.M.G., F.R.C.V.S.

In this account of Monro's tube, which was mentioned annually in his lectures, there is a letter quoted from a former student of Monro's, dated 1779, in which he says that hearing what Monro said at his lecture about the tube, he would like to inform him that his grandfather, a grazier of Norfolk, always treated his cattle that swelled after eating clover by passing a stiff cart rope into the stomach, which let out the gas and produced an immediate cure.

The second to employ the stomach tube for practical purposes in medicine was John Hunter, a famous surgeon of London, who, on September 21st, 1790, read to the Society for the Improvement of Medical and Surgical Knowledge a paper on " Artificial Mode of Conveying Food and Medicine into the Stomach," describing it as effecting a cure in a case of paralysis of the muscles of deglutition. The apparatus he used was made of fresh eel skin of rather small size, drawn over a probang and tied up at the end where it covered a sponge, then tied again close to the sponge, where it was fastened to a whalebone. A small longitudinal slit was made into it just above this upper ligature. The other end had a bladder and a wooden pipe attached, similar to that used in giving a clyster, the pipe being large enough to let the end of the probang pass into the bladder without filling up the passage. The probang thus covered was introduced into the stomach, and the foods and medicine were placed in the bladder and squeezed down through the eel skin. He states that this tube produced no irritation, and allowed great liberty to be taken, inasmuch as it was smooth, pliable, and readily passed into the stomach. But as cases of this kind might occur where eels could not be procured, it was stated that a portion of the gut of any small animal, as a cat or a lamb, might be substituted.

Alexander Monro, Professor of Anatomy at the University of Edinburgh, and a distinguished comparative anatomist and physiologist, in his inaugural thesis, " De Dysphagia," in 1797, recommended the stomach tube for use in cases of poisoning, for the extraction of poison from the stomach, and also recommended it for the introduction of food into the stomach in cases of dysphagia, and for the extracting of gases and food from the stomach in cases of gastric fermentation in cattle, calling attention to the use thirty years before of the stomach tube invented by his father, already described.

Barron Larrey, Sr., French Army Surgeon, records the use of a stomach tube for artificial feeding, and for the withdrawal of stomach contents (Larrey: " Mémoires de Chirurgie Militaire," Paris, 1812). This was in 1799, and was used by him with success in the nourishment of tetanus patients, and in the case of Marshal Murat, who had a badly wounded neck. In statements by some writers they seem to attribute Larrey's employment of the tube as that of simple œsophageal intubation, basing this on the fact that he stated: " We could not determine whether the tube was in the larynx or pharynx until a few drops of

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liquid had been introduced ; if in the former, a suffocating cough was the result." Even in our latest writings of to-day on passing the stomach tube, it is recorded that on occasions the tube is passed into the larynx. Text-books caution about this, and record possible cases of death from introducing lavage fluid by the operator not recognising the wrong entrance of the tube. Hence Larrey's directions are not remiss for a pioneer or even now. After reading about the Baron's handling of the cases treated, there is no doubt in my mind that the flexible tube used by Larrey entered the stomach, as it would have been impossible for him to have accomplished withdrawing the contents of the stomach by a simple œsophageal intubation.

Dr. Philip Syng Physick, Professor of Surgery at the University of Pennsylvania, successfully employed the stomach tube in cases where poisonous substances had been taken, through which tube fluid might be injected by a syringe and extracted again, thereby enabling the practitioner to remove such noxious substances from the organ (Physick : " Eclectic Repertory and Anyl. Rev.," 1812, Friedenwald, *Johns Hopkins Hospital Bull.*, September, 1903). That was prior to 1800. He recommended this method of treatment in his lectures on surgery. He employed a large flexible catheter and attached a common pewter syringe to the exposed end of the tube. In 1803, his nephew, Dr. Dorsey, was in Paris, and had made by Dr. Physick's order a tube of the kind now generally used, constituted of the same materials as the French catheter, and resembling it except in size.

In the London Medical Repository, May, 1822, Edward Jukes, of Westminster, described his stomach tube used for removal of opium and other poisons from the stomach, and in the *London Medical and Physical Journal*, November, 1822, and June, 1823, he had further articles on his tube and its uses. It was made of elastic gum, a fourth of an inch in diameter, and two and a-half feet in length, terminating at one extremity in a small globe of ivory with several perforations ; the other extremity was adapted either by screw or by plug (the latter is preferable), to an elastic bottle of sufficient size to contain at least a quart of liquid, and having a stop cock fitted to it in a similar manner to the flexible tube. It was recommended in cases where the surgeon had neither a bottle nor a syringe. The tube alone might be able to answer the purpose, if the operator applied his mouth to the opening and instituted the office of syphon. This was recommended for use in lavage and gavage, and from the description would seem to be somewhat similar to the duodenal tube in use to-day. The first experiments carried out by Mr. Jukes were on dogs, then on himself and others, assisted by Mr. James Scott, surgeon in Westminster.

Francis Bush, of Frome, had an article in the September, 1822, issue of the *London Medical and Physical Journal* on the removal of opium and other poisons from the stomach by means of a flexible tube. The tube recommended by him was one to one and-half inches in circumference, made of elastic flexible material, with a point to enter the stomach described as being smooth, and furnished with holes like a catheter ; these holes to be four or six in number, and as large as

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the tube would admit. By attention to this part of its construction even the more solid, as well as the fluid, contents of the stomach could be brought from it when the piston was made to act. With this tube he used a syringe, and stated that it should not be permanently fixed to the tube, but so constructed that they could be put together and separated instantaneously. He also recommended a stilette made of whalebone to facilitate passage of the tube into the stomach.

In 1823, Mr. Reed, of Horsmonden Lane, Kent, made an improved stomach pump that was introduced with success in the wards of Guy's Hospital, London, through the good offices of Sir Astley Cooper (Garrison: *Bos. Med. and Surg. Journ.*, February, 1916). In a lecture by Sir Astley Cooper on the use of Reed's instrument at Guy's, he stated that they were indebted for it to Mr. Jukes, who originally employed a common elastic bottle applied to the tube, but the improvement of a syringe in its place was suggested by Mr. Bush, of Frome. Thus the stomach tube became popularised in English practice.

In Germany, A. Kussmaul was instrumental in introducing and popularising the stomach tube. He made his first report on the tube and its practical use in medicine in September 19th, 1867 (Kussmaul: Tagebl. d. 41 Versamml. *Deutsche Naturf. u. Aerzte*), and in the official bulletin of the University of Freiburg that was issued in celebration of the birthday of Grand Duke Friedrich, in 1869, published a monograph, "Ueber die Behandlung der Magenerweiterung durch eine neue methode mitteltst der Magenpumpe."

William Leube, with his articles on lavage and gavage (Leube: *Deutsch. Arch. f. Klin. Med.*, 1876), also deserves credit for furthering this work.

The introduction of this valuable instrument to the practice of both veterinary and human medicine demonstrates how closely allied are both branches of the medical profession.

Acknowledgment is hereby made to Major Geo. W. Dunkin, of the National Institute for Medical Research, Mill Hill, London, for his kindness in helping me to obtain certain historical data contained in this article; and to Dr. Bullock, the Secretary and Registrar of the Royal College of Veterinary Surgeons, for his courtesy in suggesting certain references.

CIRCLING DISEASE: A MENINGO-ENCEPHALITIS OF SHEEP IN NEW ZEALAND.

Notes on a New Species of Pathogenic Organism.

By DUDLEY A. GILL, M.R.C.V.S., D.V.S.M.
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SINCE the preliminary description of this condition was published in 1931,[1] further work on the problem has been carried out, and has clarified the position considerably. In the notes referred to it was mentioned that where organisms

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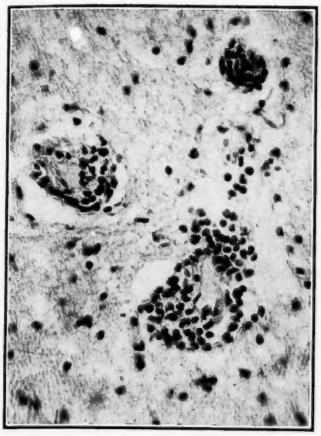

FIG. 1.—Perivascular Cuffs. Cerebrum of Hogget 241 after inoculation of culture intracerebrally. (Hæm. and Eos.).

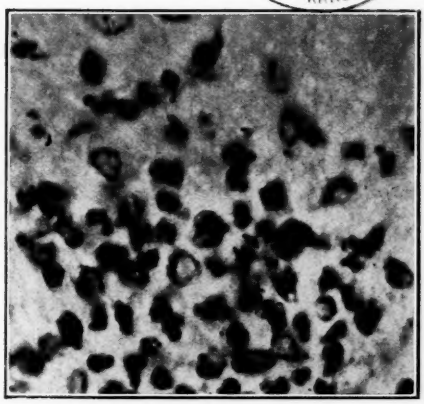

FIG. 2.—"X" organism in lesion of a natural case. *C. quadrigemina*. (Gram-Jensen).

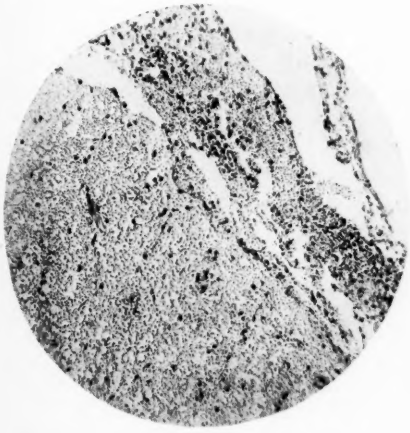

FIG. 3.—Spinal cord of rabbit showing meningitis induced by intravenous injection of "X" organism. (Hæm. and Eos.).

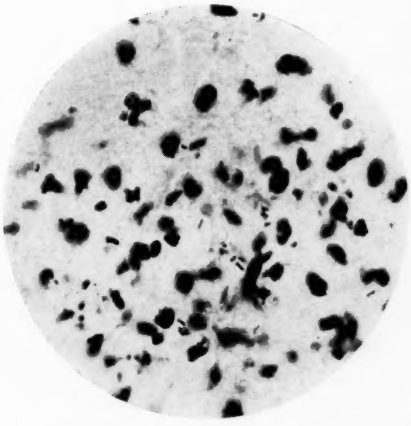

FIG. 4.—"X" organisms in inflamed meninges of rabbit, induced by intravenous injection. Compare with Fig. 2. (Gram-Jensen).

(*Article by* Dudley A. Gill, *page* 258)

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were seen in the brain lesions they appeared to be Gram-positive rods, but that this organism had not been obtained culturally.

In 1931 a living affected sheep was kindly obtained by Mr. A. L. Thompson, M.R.C.V.S., and from its brain a pure culture of the Gram-positive rod was obtained. A description of this organism will be given below, as it appears to be a new species, and is decidedly pathogenic. It is particularly easy to cultivate, but to obtain it with reasonable certainty from an affected brain it is necessary to use a different technique to that which was followed in 1930. This probably explains our failure to obtain it from the cases dealt with in that year. In 1932, cultures of it were obtained from four other affected sheeps' brains—the only four dealt with. In three of these it was again present in pure culture, and in the other it formed about 20 per cent. of a very mixed growth. The organism is only present in the actual lesions in the brain, and these may be fairly scanty. It therefore follows that if cultures are simply sown by plunging a needle here and there into the brain substance the material so obtained for the inoculation of media may contain none of them. As the lesions are generally confined to the corpora quadrigemina and surrounding portions of the brain, medulla and pons, we now cut out a portion of the brain substance about the size of a hazel nut from that area, triturate it aseptically with sterile sand, and sow blood agar plates from the emulsion that is thus obtained.

On receipt of the affected sheep in 1931, the animal was killed, and its brain aseptically removed. In addition to making cultures and putting portions aside for histological examination, a 20 per cent. emulsion of the brain in 50 per cent. glycerine-saline was prepared. This was thoroughly shaken and filtered through sterile cotton wool. Cultures were put up from the filtrate, and 1 c.c. of it injected intra-cerebrally into each of two hoggets (Nos. 225 and 226). The remainder was again cultured, as a check against contaminations, and placed in cold storage for further reference if required. The cultures that were made both before and after use gave a pure growth of the organism under discussion. Both hoggets showed a gradual rise of temperature till on the fifth day No. 225 reached 105.6° F. and No. 226 was 104.8° F. On the sixth day No. 226 had dropped to 103.4° F., and thereafter became normal in every way; No. 225 remained at about 105° F., and by the sixth day was very noticeably somnolent. Thereafter it developed typical symptoms of "circling disease," being killed when moribund on the eighth day after inoculation.

The skull wound had healed perfectly, and the point at which the needle had entered the brain was not detectable with the naked eye. The cerebro-spinal fluid was cloudy, and contained much globulin and large numbers of cells, cultures yielding scattered colonies of the organism. On opening the inoculated cerebral hemisphere, a small area of greenish, partially broken-down brain substance was found, smears and cultures of which showed a heavy pure flora of the organism in question (for brevity this organism will hereafter be referred to as "X"). Sections from the lesion and the surrounding brain showed intense polymorph

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and lymphocyte infiltration, together with large numbers of X where the injection was sited. Near this were vessels showing perivascular cuffing, and isolated foci exactly similar to those seen in natural cases were found even at some distance from the point of inoculation in the cerebrum and thalamus.

Effect of X on Rabbits.

Three rabbits were inoculated with pure, first generation subcultures. Nos. 1 and 3 received 1 c.c. each intravenously, and No. 2, 1 c.c. intraperitoneally.

No. 1 was found dead in forty-eight hours. Autopsy showed miliary foci in the liver, appearing as minute yellowish-white areas, and intense hæmorrhagic meningitis. Cultures from heart blood and meninges gave pure growths of X.

No. 3 was found dead in seventy-two hours, showing similar lesions to No. 1. Sections of the spinal cord and liver showed that the foci in the latter were composed of necrotic liver tissue heavily invaded with polymorphs and containing large numbers of X. The spinal cord showed intense congestion of the meninges and vessels of the cord, with hæmorrhage into the substance of the cord. The meninges were also thickly infiltrated with cells, mainly polymorphs, and X was to be seen there in enormous numbers. It could not be seen in the hæmorrhagic areas of the cord.

No. 2 (intraperitoneal) remained unaffected.

In a further series of five rabbits, three received intravenous injections, one received culture insufflated into the nostrils, and one was dosed with culture by means of a stomach tube. In this series, fourth generation broth subcultures were used.

No. 4 (0.25 c.c. intravenously) found moribund, and killed at forty-eight hours. Post-mortem examination and cultural results were just as in the previous cases. The brain showed no lesions in sections, but the inflamed and hæmorrhagic condition of the meninges and hæmorrhages into the substance of the cord were very marked.

No. 5 (0.5 c.c. intravenously) was practically moribund at seventy-two hours, but then commenced to improve, making daily progress, till on the eighth day it appeared normal though very weak. It was killed by chloroform. Autopsy revealed numerous small caseated areas in both lungs, slight liver lesions, and extensive lesions in the myocardium. The brain and cord appeared normal. Cultures yielded scanty, pure growths of X from meninges, lung, liver and myocardium. Blood cultures were sterile. Sections showed the organism to be present in the pulmonary and myocardial lesions, but they could not be detected in those of the liver. Brain sections revealed three small but typical foci in the pons, but no organisms could be seen in them.

No. 6 (1 c.c. intravenously) was found dead at seventy-two hours. Lesions, etc., similar to No. 4 in every way.

No. 7 (1 c.c. per stomach tube) remained apparently unaffected. Temperatures were not taken.

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No. 8 (1 c.c. insufflated into nostrils) developed an acute purulent nasal catarrh, commencing on the fourth day, and increasing till the eighth, after which it quickly subsided, leaving the animal apparently unaffected.

Still other rabbits have been inoculated intravenously with the 1931 strain after it had been subcultured for a period of some fourteen months in slope cultures. The results were similar in every way to those in the cases dealt with above, and are illustrated in Figs. 3 and 4. The X organism is therefore distinctly pathogenic for rabbits. It tends to invade the tissues, causing a local tissue-necrosis, and appears to have a special predilection for the meninges and the liver, other tissues being invaded later if the animal survives long enough.

Intravenous Injection of X into Sheep.

Four hoggets received doses of broth cultures intravenously (2 c.c., 2.5 c.c., 5 c.c. and 9 c.c.). The cultures used varied from the fourth to the tenth broth subculture. These sheep all showed a marked rise in temperature (106.6° F. to 108° F.), which continued for some forty-eight hours, and then subsided during the next few days to normal (about 103° F.). None of them showed any symptoms more pronounced than a transient loss of appetite, etc., when the fever was at its height.

Attempts to Discover the Possible Presence of a Filtrable Virus.

The position at this stage was that in many cases of "circling disease" organisms in the form of Gram-positive rods could be seen in some of the lesions, and such an organism, which was obviously pathogenic and seemed to have a predilection for the meninges, had been obtained from a typically affected case. Nevertheless, the general nature of the lesions in natural cases, apart from the presence of this organism, and particularly the extensive perivascular cuffing which has been an outstanding feature of all cases investigated, were suggestive of the activities of a filtrable virus. Sections could readily be photographed from cases of circling disease which would serve as well to illustrate the histo-pathology of louping ill, for example, as those published by Brownlee and Wilson.[2] Moreover, with the possible exception of rabbit No. 5, no encephalitic foci had been set up by the X organisms action in rabbits, and the lesions in Sheep 225, though strongly suggestive, were not actually typical of a natural case of the disease. It was therefore considered highly necessary to discover if possible whether or not the X organism was functioning as a secondary infection, following in the wake of a filtrable virus.

Experiments with Glycerinated Brain Emulsion.

The brain emulsion in 50 per cent. glycerine-saline which had been placed in cold storage was examined culturally at intervals in the expectation that X would die out, leaving any filter passer that might be present still viable and infective. After a week's storage cultures still gave a fairly heavy pure growth, but after sixteen days all cultures were negative. The emulsion was then left in cold storage a further week, and since at the end of that time cultures were again

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negative, it was assumed that X was no longer present in a living state. A dilution equivalent to 5 per cent. brain substance in 50 per cent. glycerine-saline was then prepared and filtered through sterilised cotton-wool, yielding a markedly cloudy liquid, but containing no obvious particles. This was used to inoculate three hoggets intracerebrally (Nos. 239, 242 and 244), the amount inoculated in each case being 0.5 c.c. No. 239 showed acute symptoms of meningo-encephalitis on the third day and was killed. No. 244 showed similar symptoms on the fourth day and was killed. No. 242 remained apparently unaffected. Autopsy in the case of Nos. 239 and 244 showed exactly similar lesions in the brain to those found in hogget 225 (inoculated from original brain emulsion), and cultures from the cerebro-spinal fluid and site of inoculation in the brain gave pure, heavy growths of X. Histological examination also showed lesions parallel to those in the case of No. 225, including occasional small perivascular cuffs at some distance from the main lesion. Although this experiment failed to throw any light on the possible presence of a filter passer, it demonstrated that very few X organisms inoculated into the brain substance are sufficient to cause an acute meningo-encephalitis.

Experiments with Seitz E.K. Filtrate of Brain Emulsion.

In 1932, brain substance from a living affected sheep was removed after death and used for this test. Cultural examination of the brain gave a pure growth of X, and subsequent histological examination revealed typical lesions. Suitable portions of the brain were emulsified in glycerine-saline, and placed in cold storage for three days to allow a virus, if present, to permeate the fluid evenly. It was then diluted with glucose broth until there was about 5 per cent. brain in 10 per cent. glycerine-glucose broth. This was gently centrifuged, and the opalescent supernatant fluid passed through a Seitz E.K. pad at 100 mm. pressure. The filtrate thus obtained, which was shown culturally to be sterile, was inoculated intracerebrally in 1 c.c. doses into two hoggets (Nos. 285, 286). Neither of these animals were adversely affected in any way. It was quite realised that negative results with a Seitz E.K. filtrate would have no real significance where a filtrable virus was suspected, but it was the only means of filtration available here at the time.

Experiment with Chamberland L. 5 Filtrate of Brain Emulsion.

It had been noted that Greig and his colleagues[3] had found the louping-ill virus to be regularly held back by candles of this type, but unfortunately we were unable to procure any of a more suitable porosity in the country at that time. In this experiment affected brain was emulsified in sterile normal saline to make a 10 per cent. suspension. This was allowed to settle overnight, centrifuged ten minutes at 2,500 r.p.m., and the supernatant pipetted off. The pH was adjusted to 7.4, and the fluid was then passed through the L5 candle at 20° C. and 175 mm. pressure, the time occupied in filtration being two hours.

The resulting filtrate was sterile on culture, and two hoggets each received 1 c.c. intracerebrally. One of them remained quite unaffected, but the other

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showed considerable dyspnœa on the second day, and was found dead on the third, autopsy revealing marked congestion of the lungs. The actual site of the injection could not be detected by the naked eye, but could be estimated fairly accurately from the wound in the skull and the length of the needle used in making the injection. Cultures from the brain and cerebro-spinal fluid were negative, and sections from the estimated site of injection showed no histological changes suggestive of the disease. Probably the death of this sheep resulted from pulmonary congestion following anæsthesia, but in any case there is no evidence that it is attributable to the injection of a virus. The necessary steps have now been taken to procure a suitable range of filter candles for such work as this, and further trials will be made during the coming season, although, as will be seen later, the presence of a filter passer is no longer considered very probable.

Further Experiments with X Organism on Sheep.

As has been mentioned above, histological examination of the brains of sheep Nos. 225, 239 and 244, in which the disease had been caused by the intracerebral injection of brain emulsion from an affected sheep, showed polymorph and round-cell foci and slight perivascular cuffing, even at some little distance from the site of injection. This might have been due to the inoculum containing some neurotropic virus in addition to X. It was, therefore, decided to test the effect on an intracerebral inoculation of a culture of the X organism itself. The culture used for the purpose was obtained as follows: A first subculture of the original affected brain was plated on blood agar. From this a single colony was picked and spread on a slope of serum agar, and a single colony from this latter was sown into beef broth, which after twenty-four hours' incubation was used for the experiment.

Hogget No. 241 received 0.25 c.c. of the above culture into the left cerebral hemisphere. At the time of inoculation its temperature was 103.1° F. By the forty-eighth hour it had risen to 105.8° F., and the animal was wandering aimlessly without feeding. By evening it was blind on one side, and was wandering in a circle with the head drooped to one side. On the following day it was moribund and was killed. On post-mortem and cultural examination conditions were found to correspond in every way with those in the three sheep infected by brain emulsion, and sections from the brain again showed foci and slight perivascular cuffing at some distance from the site of inoculation (*see* Fig. 1).

Injection of X into Carotid Artery.

As intravenous injections in sheep had failed to cause more than a transient fever, Dr. C. J. Reakes, D.V.Sc., suggested injecting X *via* the carotid artery as a means of sending it more directly to the brain, and this was done.

Hogget No. 280, having an initial temperature of 103.5F., received 1 c.c. of a culture similar to that used in the last experiment direct into the carotid artery, which was exposed for the purpose under local anæsthesia. During the following four days the temperature fluctuated between 106° F. and 107° F.,

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and the animal gradually became dull and somnolent. On the sixth day there were definite signs of encephalitis, the animal spending its time with head drooped to the right, and apparently sleeping on its feet. If roused it moved with a stumbling gait with its head held to the right, and a tendency to circle in that direction. The following day it was moribund and was killed. There were no visceral lesions, and though the blood gave a polymorph count of 61 per cent., it and the liver were sterile on culture. The cerebro-spinal fluid was cloudy, with a cell content of over 5,000 per cm., and on culture yielded a very few colonies of X. The brain itself was not macroscopically abnormal, though there was an obvious meningitis, but cultures from several areas gave very heavy, pure growth of the organism.

The histological examination of sections from the mid-brain showed lesions that were typical of the naturally occurring disease. There were foci of cellular infiltration, some of which contained the organism and many polymorphs, while others were smaller, contained no organisms, and were composed of lymphocytes and neuroglial cells. There were also some well-marked perivascular cuffs. The only feature which distinguished some of the sections from those of a natural case was the presence here and there of a capillary with somewhat infiltrated walls whose lumen was plugged with the organism. The strain used in this experiment was one of those obtained in 1932. A further sheep was similarly inoculated, using a broth culture of the 1931 strain which had then been subcultured for over fourteen months. The result in every way was entirely on a par with the other. The lesions produced by this means, and their similarity to those of natural cases, are well illustrated by Figs. 5 and 6.

Experiments with X Administered to Sheep per Stomach Tube.

Hogget No. 288, which had an initial temperature of 103.3° F., was given 10 c.c. of twenty-four-hour broth culture from one of the 1932 strains every morning for seven days by means of a stomach tube. After the first dose the temperature rose to 105.8° F., and after the second to 106.2° F. After the third dose the temperature had fallen to 105° F., and thereafter it quickly returned to normal in spite of the continued dosing. It is felt that the early rise in temperature was due to the effect of the organism, and not to excitement induced by handling the sheep. Possibly more definite results would have been obtained if more sheep had been drenched in this way.

Subcutaneous Injection of X in Sheep.

Injection of 1 c.c. doses of twenty-hour broth cultures subcutaneously in the thigh of two sheep and one rabbit caused no apparent local reaction, nor were any general effects noted.

Infection of Sheep with X *via* the Nasal Passages.

Hogget No. 287, whose initial temperature was 103.8°, received 0.5 c.c. of twenty-four hour broth culture insufflated into the nostrils with an atomiser

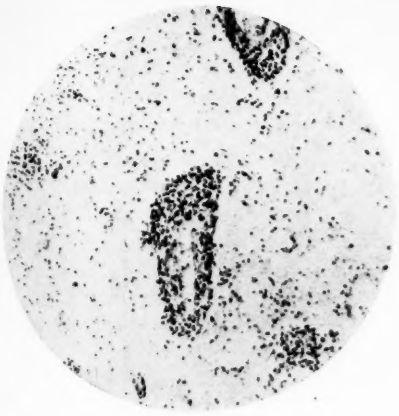


FIG. 5.—Lesions in *C. quadrigemina* of sheep caused by intra-carotid injection of "X" organism. (Gram-Jensen).

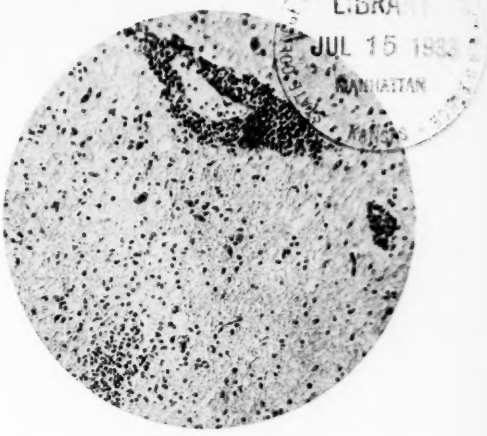


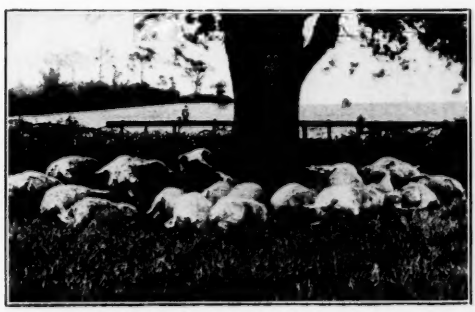
FIG. 6.—Lesions in *C. quadrigemina* of natural case for comparison with Fig. 5. (Hæm. and Eos.).

(*Article by* Dudley A. Gill, *page* 258)

Showing source of cases from which encephalitis organism has been obtained.

(*Article by* Dudley A. Gill, *page* 258)

Here the lightning ran along the fence.



A group of dead sheep under an oak tree.

(*Article by* S. J. Motton, *page* 275)

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each day for five days. After the first dose the temperature rose to 104.8° F., and there was slight nasal catarrh. Thereafter the temperature remained normal, and the nasal catarrh abated in spite of the further dosing.

Hogget No. 286, whose initial temperature was 104° F., was drenched *via* the nostril with 10 c.c. twenty-four-hour broth culture each day for six days. First day: Temperature 108° F., animal dull. Second day: temperature 107.7° F., dull, snuffling respiration. Third day: temperature 107.5° F., animal appeared slightly better. Fourth day: temperature 107.2° F., animal again dull. Fifth day: temperature 107° F., dull, salivating, slight dyspnœa. Sixth day: temperature 106.4° F., dull, purulent nasal discharge, marked dyspnœa. Seventh day: temperature 105.2° F., animal somnolent, copious nasal discharge, disinclined to stand, head held to right side, and tendency to circle in that direction.

By noon of the seventh day the animal could only stand with assistance. When held up it turned on its own axis to the right. It was moribund by afternoon and was killed. At death the blood gave a polymorph count of 67 per cent., but was sterile on culture. The cerebro-spinal fluid was cloudy, Pandy's globulin test was strongly positive, and the cell count exceeded 5,000 per cm.; cultures yielded a small pure growth of X. The abdominal viscera appeared normal, but cultures of liver substance gave a small growth of X. The lungs both showed a large area of grey hepatisation containing a heavy mixed flora, including a small number of X. The nasal mucosa, turbinates, lateral masses of the ethmoid, and pharyngeal mucosa were all congested and catarrhal. Cultures from the turbinates and external orifice of the Eustachian tube gave fairly heavy growths, with X predominating. Cultures from the lateral masses yielded a small mixed growth including only a few colonies of X. The brain and cord showed some degree of meningitis, and cultures from the brain substance gave very heavy pure growths of X. Histological examination of brain sections in this case revealed well-marked meningitis and a diffuse encephalitis. Foci of cellular infiltration were very scanty, and although a few of the capillaries showed an excess of cells in their walls, one could find no perivascular cuffing resembling that in natural cases.

The earlier symptoms shown by this animal pointed to some degree of pneumonia, and it is therefore worth mentioning that it always appeared to swallow the liquid which reached its pharynx during dosing. At no time was there anything to suggest that some of it had entered the trachea. In this case, therefore, an undoubted meningo-encephalitis had been induced, but the lesions were not strictly comparable with those of a natural case, and it was decided to make a further trial. A third hogget received a single dose of 10 c.c. broth culture *via* the nostril, this time using the 1931 strain which had been subcultured for over a year.

Hogget No. 290: initial temperature 103.6° F. First day: temperature 106° F., dull, slight dyspnœa. Second day: temperature 107.2° F., condition

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unchanged. Third day: temperature 107° F., breathing hurried, appears ill, still feeding. Fourth day, temperature 107° F., condition unchanged. Fifth day: temperature 107° F., dyspnœa, feeds a little, but scarcely seems conscious of its own actions. Sixth day, temperature 106.8° F., condition worse, tendency to stumble when moving; cerebro-spinal fluid withdrawn by lumbar puncture shows normal cell content, but Pandy's test faintly positive. Seventh day: temperature 105° F., condition unchanged. Eighth day: temperature 104.6° F., somnolent, salivating considerably; if forced to move shows marked inco-ordination, but no tendency to circle. This sheep became moribund during the eighth day, and was killed. At death the cerebro-spinal fluid was definitely cloudy, Pandy's test positive, and the cell content over 1,200 per cm. Post-mortem examination revealed similar lung lesions to those in No. 287, in fact the post-mortem picture and histological examination of the brain gave precisely similar findings. Cultural examination in this case, however, yielded heavy pure growth of X from the blood, lungs, liver, and cerebro-spinal fluid and small pure growths from the cerebrum and mid-brain. A search for the organism in the duodenum and cæcum was negative.

Discussion on Relationship of X to "Circling Disease."

From these experiments with sheep it is obvious that X is definitely pathogenic for that species, and when administered by the nostrils has a marked tendency to affect the lungs. Probably there is a local infection of the nose and throat which spreads possibly by the lymphatics to the lungs and thence, by constant seeding of the blood-stream or lymphatics, it reaches other organs, notably the brain. That the organism does play an important part in the causation of this disease is strongly suggested by the facts that where organisms have been seen in the lesions of natural cases they have invariably been of this type, and that in the last five consecutive cases X has been obtained culturally from the affected brains: in four cases in pure culture, and in the fifth as the predominating organism. Moreover, while two of these cases came from the same farm, the other three were from widely separated districts (*see* map). Similar cultural methods have been applied to the brains of several sheep dead of other causes without this organism ever having been detected. The experiments detailed above point to the organism having something of a predilection for the meninges and brain, and a very definite meningo-encephalitis can be induced by its artificial use. It can be claimed that lesions practically parallel to those of the naturally occurring disease have been induced by inoculation of the organism into the carotid artery of sheep.

The problem is one of considerable interest. If, as now seems most probable, it is eventually demonstrated that X is the sole direct cause of the disease, it will show that lesions of a type previously regarded as typical of the action of a neurotropic virus may in fact be induced by a demonstrable microbe. On the other hand, if further trials demonstrate the presence of a neurotropic virus, the close association of the organism with the virus in the same lesions will be

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most unusual. It might be analogous to the streptococcus which Rosenou[4] has found in the nerve tissue of cases of epidemic encephalitis of man, and with which he has induced lesions in experimental animals that are similar to those induced in sheep by the carotid or intracerebral injection of X.

Incidence, etc., of the Disease.—During 1932 the writer sent questionnaires to the veterinarians and stock inspectors in whose districts the disease was reported, and they were good enough to distribute them to farmers who had experienced losses. Questions were answered in ten cases, and these ten replies may be summarised as follows:

Total sheep in the ten flocks, 25,750. Loss in 1930, 133; loss in 1931, 93; loss in 1932, 88.

Age of sheep affected: from two-tooths to aged sheep, but generally two to six tooths.

Period of loss: Six named March to May; one, December; one, January to March and again in July; one, May and June; one, July.

Do any recover? Three had each known of one recovery, the others of none.

Is there much nasal discharge in the flock at the time? Nine, no; one, yes.

Do weather conditions affect incidence? Seven, no; three, deaths occur after a dry spell of weather, and cease when the rain comes.

Do any flies "blow" the sheep's nostrils at that time? Nine, no; one, a fly (evidently *Œstrus ovis*) noticed worrying the sheep some weeks before disease appeared.

In addition, Mr. A. L. Thompson, M.R.C.V.S., of Wanganui, made inquiries, and reported as follows: "This disease is common all up and down this coast (Southern Taranaki). All ages of sheep are affected, and the disease makes its appearance about February, continuing until May or even June. A peculiar feature is the tendency for sheep in one paddock to become affected, while those in the next paddock escape. This would appear to coincide with the habit of the sheep nostril fly, which apparently does not travel very far, but confines its activities to limited sunny localities. The mortality this year varies between 2 per cent. and 3 per cent."

One has given some thought to the possibilities of flies as vectors of this disease, especially since the finding that X was pathogenic for sheep *via* the nostrils. The disease occurs mainly between February and June, and *Œstrus ovis* is on the wing in this country for the most part about February, but although *Œstrus* larvæ have been found in the sinuses of one or two of the affected sheep, in most of them they have been conspicuously absent. It is possible, however, that the nasal mucosa is infected by the larvæ when migrating from the nostrils towards the sinuses, and that the congestion and catarrah so caused leads to the death or expulsion of the larvæ before they can become established. Such a possibility will be investigated. Pneumonia in sheep connected with *Œstrus* larvæ in the trachea, as reported by Bissett,[5] is of interest in this connection also. In the majority of the cases in which a complete post-mortem examination has been made

there has been nothing to suggest that a heavy infestation with nematodes had provided a portal of entry for the infection.

The writer[1] has mentioned having seen a sheep that may have been affected with this disease in Wales, in 1929. Dr. H. W. Bennetts, in a personal communication, has stated that he believes the disease to occur in Western Australia, and Doyle[6] has described a disease of sheep in Indiana, U.S.A., which is almost certainly of the same nature. It seems, therefore, that the condition may be of fairly wide occurrence, and of higher incidence than at present appears. More especially is this the case since a disease with very similar symptoms, but without a demonstrable meningo-encephalitis, occurs among sheep, apparently due to digestive disturbances, and the two conditions may readily be confused with each other. One simple and valuable aid to differential diagnosis in this connection is that whereas in the meningo-encephalitis the cerebro-spinal fluid is invariably opaque to some extent, in the purely dietetic condition it is of normal water-clearness.

Description of X Organism.

Five strains of this organism have been examined, and all are in entire agreement according to all tests so far applied.

Morphology and Staining.—It is a small rod-shaped organism, two to three times as long as it is broad, and about a quarter the size of *Bacillus welchii*. It does not form spores. It is strongly Gram-positive, and stains quite evenly throughout. It is not acid-fast. In most media it occurs as single elements with a slight tendency to " pallisade " formation, as is seen in many of the Corynebacteria. After a few days' incubation the water of condensation of Loeffler's serum slopes contains a number of long unsegmented forms. Other involution forms have not been seen, and even in old cultures stained by Neisser's method there is no trace of barred or granular staining.

Motility.—All strains are definitely motile, generally moving by somersaults. After prolonged trials flagellar staining was successful, and showed the presence of a single polar flagellum.

Conditions for Growth, etc.—It is an aerobe, and grows with ease on the ordinary laboratory media. It will grow at 15° C., but a quicker and much more luxuriant growth occurs at 37° C. Colonies are visible at 37° C. in a few hours, and reach almost their maximum size in twenty-four hours, whereas at 15° C. and 22° C. they are invisible till about the thirty-sixth hour. Plain agar gives a much less luxuriant growth than glucose or lactose agar. Colonies are greyish on all solid media; no culture has ever shown chromogenic tendencies. Broth cultures show uniform slight cloudiness. There is no pellicle formation, and sedimentation only occurs after several days.

Fermentations.—Using serum broth, with 1 per cent. carbohydrate test substances and Andrade's indicator, all strains actively ferment glucose and salicin. With lactose there is very slight acid production by recently isolated cultures, but this property tends to disappear with repeated subculturing. Saccharose, raffinose, mannite and inulin are not fermented.

Other Cultural Reactions.—Litmus milk is completely bleached in twenty-four hours, but is otherwise unchanged . After forty-eight hours the colour gradually returns, commencing at the bottom of the tube, and by the end of a week the medium appears as it was before inoculating. Blood agar gives an excellent growth, and each colony is surrounded by a zone of hæmolysis about 1 mm. in width. Gelatine is not liquefied, stab cultures giving a whitish, beaded growth along the whole length of the stab. Indol is not produced, nor are nitrates reduced.

Discussion.

The organism described does not appear to fit into any recognised genus so far as one can discover. In the past there has been a general tendency to place almost any Gram-positive organism derived from animal and other sources into the " diphtheroid " group, if they did not obviously belong to any other genus. Of recent years several efforts have been made to produce some sort of order out of the more or less chaotic state of affairs that resulted from this general " dumping " process, and certain criteria have been widely accepted to which an organism should conform before it can continue in the genus Corynebacterium. The American Society of Bacteriologists[7] give the following as the generic characters of the Corynebacteria : " Slender, often slightly curved rods with tendency to club, and pointed forms ; branding cells reported in old cultures ; barred, uneven staining ; not acid fast ; Gram-positive ; *non-motile*, aerobic ; no endospores." The Bacteriological Committee of the Medical Research Council of Great Britain, 1923,[8] agree with this description, except that they consider strict aerobiosis should not be insisted on as a generic character. The characters given by this authority also embrace a general tendency to irregular staining (granules, segments, etc.), and non-motility. From a perusal of the " Annals of the Pickett-Thomson Research Laboratory,"[9] one gathers the impression that branching forms, irregular staining, etc., may not be shown by an organism, and it may yet be eligible for inclusion among the Corynebacteria, but that non-motility is definitely one of their basic characteristics. For instance, *Bacillus endocarditis griseus* (Weichselbaum) was classified by Flügge (1896) as a type of pseudo-diphtheria organism, or diphtheroid. It is Gram-positive, shows irregular staining and has chromogenic tendencies (a common feature of many true diphtheroids). But it is actively motile, and, Eberson[10] considers, should not be included for that reason, motility not having been detected in the " diphtheria group." Again, commenting on the classification as a " diphtheroid " of an organism described by de Witt in 1912, the authors of the Pickett-Thomson volume (*loc. cit.*) say : " The fact that she states that this organism was actively motile rules it out of the diphtheroid genus, all of whose members are supposed to be non-motile." Topley and Wilson[11] say of the Corynebacteria : " Absence of flagella and lack of motility are characteristic of the genus." Buchanan,[12] too, refers to absence of motility.

If it is conceded that this organism is not a Corynebacterium, one is still faced with the problem of finding another recognised genus in which it can be more

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suitably placed. It appears to belong definitely to the order Eubacteriales, and since it grows well on ordinary laboratory media, better at 37° C. than at lower temperatures, is definitely pathogenic for animals, does not form spores, and is neither coccus, vibrio, nor spirillum, it follows that it must be placed in the family Bacteriaceæ. Of this family there are two groups of tribes, *viz.*, Group 1, those comprising the parasites and saprophytes of plants, and whose optimum temperature is 30° C. or less ; and Group 2, those which are parasitic for animals, and whose optimum temperature is 37.5° C. The organism under consideration should, therefore, be in this second group, which comprises Pasteurelleæ Klebsielleæ, Hæmophileæ, Bacteriæ and Bacteroideæ. The first three of these can be ruled out at once on morphological and tinctorial grounds. The tribe Bacteriæ contains no genus embracing Gram-positive organisms, and the Bacteroideæ are obligatory anaerobes. As Topley and Wilson (*loc. cit.*) point out, there is no classification of micro-organisms which can be regarded as final at present, although that which has been recommended by the American Committee forms a useful basis. Since, therefore, the organism in question does not appear to be amenable to classification under this system it seems best in the meantime to call it " the New Zealand ovine-encephalitis organism."

Summary.

Details are given of further work in connection with a meningo-encephalitis affecting sheep in New Zealand. It is known locally as " circling disease," on account of one of the more obvious symptoms shown. A new species of pathogenic organism is found in association with the brain lesions, and this is described. It is pathogenic for rabbits as well as sheep, and appears to have a predilection for the meninges and nerve tissue. Sheep have developed a pneumonia and meningitis as a result of drenching with broth cultures of the organism *via* the nostrils. Some success has attended the efforts made to set up lesions in the brain that are similar to those seen in natural cases. This has been accomplished by inoculation, after over a year's subculturing, into the carotid artery of sheep. The nature of the lesions in natural cases suggested that the organism may be functioning in combination with, or secondarily to, a neurotropic virus. This is discussed, and some facts that have been gathered about the epidemiology of the disease are included. The organism described does not appear to fit into any recognised genus, and a definite name for it cannot therefore be suggested in the meantime.

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THE PIGMENTATION OF THE UTERINE MUCOSA IN THE EWE.

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THE fact that the mucosa of the sheep's uterus is sometimes deeply pigmented was recognised by Bonnet, who showed that the pigmentation was due to the presence of a sub-epithelial layer of pigment-containing cells ; he found pigment only after œstrum and in early pregnancy, and concluded that it was of hæmatogenous origin. Extravasated blood, he believed, was transformed into an amorphous brown pigment, which was taken up by the wandering cells of the connective tissue, and transported by them to the epithelium ; this formed a barrier to further migration, and the cells flattened out and anastomosed with one another. Bonnet had not, however, observed extravasation of blood.

Kazzander also thought that the pigment was of hæmatogenous origin, but he believed that the pigment was extracellular, the appearance of pigment cells being due to the grouping of pigment granules around connective tissue nuclei. He thought also that each erythrocyte retained its identity when transformed into pigment. Marshall confirmed Bonnet's observations in most respects, and the view that the sheep's uterine pigment is derived from blood extravasated during œstrum appears to have been adopted generally.

A thorough investigation of reproductive phenomena in the ewe which has recently been made involved the examination of more than 2,000 uteri from ewes killed in all stages of the reproductive cycle, and provided an opportunity for a re-examination of the nature of the pigment and of its relation to reproductive activity.

Contrary to the findings of Bonnet and Marshall, it has been found in the present investigation that neither the occurrence of pigmentation nor its intensity bears any relation to the stages of reproductive activity. Bonnet found the pigment only after œstrum and in early pregnancy ; Marshall found it only during the dioestrous cycle, and not in anœstrous or prepubertal animals. Pigment has been found by the writer not only in the uteri of anœstrous and prepubertal ewes, but also in the uteri of fœtal lambs, and pigmentation was just as frequent and as intense in sexually immature animals as in mature ewes. It seems probable that breed differences exist in the occurrence of pigment, for Bonnet found it in only 7 per cent. of 200 uteri examined (Merinos and " Zackelschafen "), while the writer found some degree of pigmentation in 80 per cent. of uteri taken at random from ewes killed at the abattoir ; on the other hand, significant differences between the various breeds examined were not established, and pigment certainly occurs in all the common Scottish breeds and cross-breeds.

In typical instances the pigment is confined almost entirely to the cotyledonary areas of the mucosa, *i.e.*, to the specialised non-glandular areas to which

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the fœtal membranes become attached (Fig. 1). This mode of distribution is found almost invariably in ewes which have not been pregnant. Rarely, the entire mucosa is black with pigment, except that the gland mouths, being unpigmented, slightly lessen the intensity of pigmentation in the inter-cotyledonary areas. During pregnancy the pigment in the cotyledons is destroyed, and in ewes which have borne lambs the distribution of pigment is much less regular than in virgin ewes : not uncommonly in such ewes the inter-cotyledonary areas alone are pigmented. In about 20 per cent. of Scottish sheep, mature and immature, the mucosa is entirely devoid of pigment. No part of the mucosa shows a greater tendency to be pigmented than the rest. Usually the pigment extends into the oviduct ; as a rule only the juxta-uterine half of the tube is pigmented, but when the pigmentation of the uterus is very intense the whole Fallopian tube, including the ampulla, may be pigmented. Pigment has not been observed in the cervix.

The account given by Bonnet of the appearance of pigmented areas in histological sections has been found to be, in all important respects, correct. Pigmentation is due to an immediately sub-epithelial layer of dendritic pigmented cells (Figs. 2 and 3) occupying the interstices of the connective tissue. Occasionally cells are found also in the deeper parts of the stroma. In the oviduct the cells are distributed throughout the mucosa and muscularis. In the fœtal uterus they are distributed throughout the mucosa. The cells are usually 12 to 30μ in diameter, and the differences in size are due to, or associated with, differences in pigment content, the large cells being much more heavily pigmented than the small. Each cell gives off one to six processes, each of which usually branches repeatedly. These processes, especially those which descend into the deeper stroma (usually along the course of a blood capillary), are sometimes of remarkable length; occasionally processes are found extending throughout the depth of the stroma of the cotyledon, a length of some 4 mm. The horizontal processes are usually much shorter than the vertical, but are, nevertheless, three to four times the length of the cell body. The processes commonly anastomose with those of adjacent cells. In outline the processes are usually grossly constricted and contorted; the end of a process is commonly blunt and dilated, like a pseudopodium of an amœbic cell. The general conformation of the cells and the fact that they are usually closely apposed to the basement membrane of the uterine epithelium suggest that these cells are capable of active movement. The circumstance that they are usually confined to the juxta-uterine part of the Fallopian tube suggests also that the pigment cells of the oviduct are derived by the migration of cells into the Fallopian tube from the uterus. Koller has described mesodermal pigment cells in the fowl which are apparently identical with those of the sheep's uterus, and these cells were shown by Koller to be actively motile in tissue culture. On the other hand, no motility was ever seen in preparations in warm Locke's solution of pieces of pigmented uterine mucosa removed from ewes immediately after slaughter, nor was streaming of the pigment seen, and it may be that these cells are stationary and that the processes in their growth expand into and fill

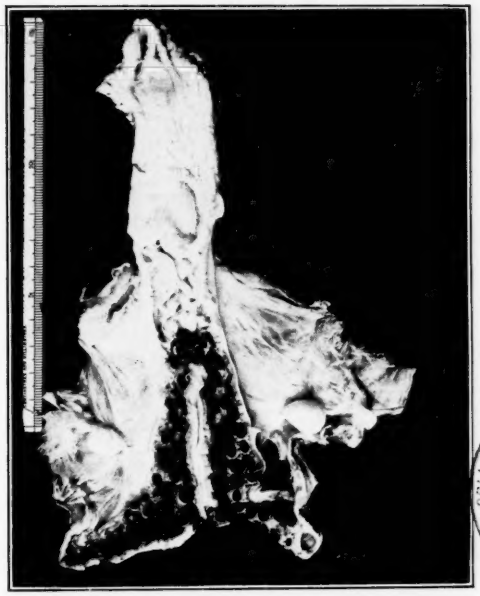

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FIG. 1.—Heavily pigmented uterus from a nulliparous ewe, showing typical distribution of pigment.

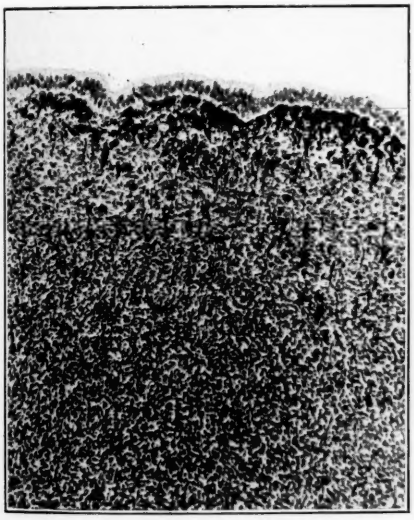

FIG. 2.—Section through a pigmented cotyledon.

FIG. 3.—Drawings to illustrate the morphology of the pigment cells. (Drawn from a thick horizontal section.)

(*Article by* R. Grant, *page* 271)

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the irregular spaces between the stroma cells, or, alternatively, that the growth of the stroma cells forces the pigment cells into their constricted and contorted form.

The pigment granules are very small and of practically uniform size and shape. The pigment was found to be insoluble in strong sulphuric acid, but probably slightly soluble in strong caustic soda. Iron could not be detected by the ferricyanide reaction in sections of pigmented mucosa, and the amount of iron found in the ash of heavily pigmented mucosæ was not appreciably greater than in the ash from unpigmented uteri. Hydrogen peroxide and chlorine bleach the pigment completely. These reactions are entirely typical of melanin, and would not be expected from any pigment of hæmatogenous origin. Apparently also, the pigment is identical with or similar to that of the skin, for in brown sheep of the Shetland breed the pigmentation of the uterus, like that of the skin and hair, is reddish-brown, while in breeds of sheep in which the skin and wool pigment is black, the pigment of the uterus is also black.

Pigment cells of an entirely different nature were found in a number of uteri from ewes killed during the puerperium or the following anœstrum. These cells were round or oval in shape, and were of a uniform pale or deep-brown colour. Their pigment was non-granular. The cells were distributed throughout the mucosa, but were particularly common in the deep tissue of the cotyledons. These cells seem to be homologous with the pigmented cells which are found in the uteri of mice, rats, etc., after pregnancy, a description of which has been given by Benazzi. The circumstance that they occur only after parturition suggests that their pigment is of hæmatogenous origin. This matter has, however, not been investigated.

Discussion.

There can be no doubt that the characteristic pigmentation of the uterus and oviducts of the ewe is not due to a pigment of hæmatogenous origin, as was suggested by Bonnet and others, but is due to the presence of melanoblasts similar to those found in the cutis of the skin, in the *lamina fucsa* of the eye, and in other situations. Identical cells were found in a number of other pelvic organs, although never in the same density as in the uterus. They were found especially in the capsules of the suprarenal glands, in the walls of the pelvic arteries and in the connective tissue sheath of the tubules of the epididymis in the male. The slight differences in form between the pigment cells found in the various situations may be ascribed to the differences in the nature of the connective tissue which they occupy. Nor can the presence of the pigment be related in any way to the physiological changes taking place in the uterus during the reproductive cycle, since pigment is found in immature and in fœtal animals.

This pigmentation of the uterus is perhaps peculiar to the sheep, for although references to pigment in the uterine mucosæ of other mammals are frequent in the literature, in no case does the pigment appear to be of comparable nature.

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The writer did not find pigment in the uteri of three goats which were examined, but Zietschmann figures the uterus of a goat which was pigmented in a manner apparently identical with that in the ewe. It is difficult to conjecture what possible functional significance the uterine pigment may possess. During pregnancy the pigment cells are very largely broken up, and the pigment is engulfed by the phagocytic cells of the fœtal trophoblast : it is possible, therefore, that the pigment is utilised by the fœtus, but the highly insoluble nature of melanin renders the validity of this hypothesis extremely improbable. No protective function such as that which is thought to be served by the melanin of the skin can be ascribed to the melanin of the uterine mucosa. Moreover, the fact that not all sheep possess this pigment increases the difficulty of suggesting any specific function for it, and it seems advisable to regard the pigment as entirely adventitious in its occurrence, and as devoid of functional significance. Similarly, it is not possible to attribute any functional significance to the melanoblasts found in other pelvic organs. It is of interest to note that heavy pigmentation of the uterine mucosa is found in breeds of sheep such as the Border Leicester and Cheviot, in which skin pigment has to a large extent been eliminated by selective breeding.

The writer wishes to acknowledge the assistance given to him by the authorities at the Edinburgh Public Abattoir, who made possible the collection of material for this and other investigations.

Summary.

(1) The characteristic pigmentation of the uterine mucosa and oviducts of the ewe is due to the presence of true melanoblasts, and not to pigment of hæmatogenous origin, as was believed hitherto. (2) Melanoblasts appear in the uterus during fœtal development, and neither the presence of pigment nor the intensity of pigmentation bears any relation to the reproductive cycle, except that the melanoblasts are largely destroyed by the fœtal trophoblast during pregnancy. (3) No physiological significance is attributed to the pigment.

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LIGHTNING STROKE.

By S. J. MOTTON, F.R.C.V.S.

Penzance.

In 1927 I read a paper at the N.V.M.A. Congress at Torquay, and it was published in the annual report of the Association that year. Nothing fresh as to the means of diagnosis has come to my knowledge since then. The accompanying photographs are printed to stimulate interest in the subject, and came into my possession through the kindness of the Yorkshire Insurance Company. They illustrate the positions in which sheep may be found when killed by lightning. It is generally believed that groups of animals attract lightning when the flash is seeking the easiest path to earth, and it has been suggested that moisture and warmth emanating from the animals may be connected with this. Animals standing under trees or in contact with wire fencing are particularly liable.

Any tree may be struck, the order of their frequency being (in America): poplar, oak, elm, conifer, walnut, ash, and beech. In England the oak is often placed first, but whether there are more oaks than poplars in the areas in which most lightning deaths occur one does not know. The richer in starches and the poorer in oils, the more susceptible are trees (Hegner). Occasional references in the press appear to suggest that blood changes are often regarded as being diagnostic of death by lightning stroke. Ordinarily the blood is black and uncoagulated, or poorly coagulated; this is important, but not diagnostic. Morphological changes, such as hæmolysis or the crenation of red blood corpuscles, have been described, but they are not constant. Tourdes and others have found no changes in the spectrum analysis of the blood.

ABSTRACT FROM THE REPORT BY THE VETERINARY INSPECTOR FOR THE CORPORATION OF GLASGOW ON THE TUBERCULOSIS ORDER OF 1925.*

It has long been universally accepted that milk is the chief vehicle of conveying the *Bac. tuberculosis* from the cow to man. The Report of the Royal Commission on Tuberculosis issued in 1895 contains the striking statement:

"*Tuberculosis matter in milk is exceptionally active in its operation upon animals fed either with the milk or with dairy produce derived from it. No doubt the largest part of the tuberculosis which man obtains through his food is by means of milk containing tuberculous matter.*"

* The full Report can be obtained through the courtesy of Mr. W. A. M. Trotter, M.R.C.V.S., Chief Veterinary Inspector, 60, Melbourne Street, Glasgow, E.1.

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Following a clamant demand for a pure milk supply, the Government placed on the Statute Book the Milk and Dairies (Scotland) Act and issued the Tuberculosis Order. These came into operation on September 1st, 1925. The objective of this Act and Order was to ensure a pure milk supply. A pure milk supply is a national necessity. A pure milk supply for the nation will not be obtained until its supervision is under national control.

The bulk of the milk supply is produced without the consuming area. The consumer is therefore largely at the mercy of the producing area. Many of the producing authorities are content with the minimum required under the Act, knowing that, were they to inaugurate a system of supervision and control worthy of the name, it would result in a considerable increase of their rates. It would be more equitable for the nation to collect by tax the money required for the supervision of the nation's milk supply. In this way not only the financial responsibilities, but the duty of supervision and control, would be borne by the whole nation.

The Tuberculosis Order directs " every person having in his possession or under his charge (i) any cow which is, or appears to be, suffering from tuberculosis of the udder, indurated udder, or other chronic disease of the udder ; or (ii) any bovine animal which is, or appears to be, suffering from tuberculosis emaciation ; or (iii) any bovine animal which is suffering from a chronic cough, and showing definite clinical signs of tuberculosis, shall without avoidable delay give information of the fact to a constable of the police force for the area wherein the animal is, or to an Inspector of the Local Authority, and the constable or inspector shall forthwith transmit the information to the Local Authority."

This Order was not intended as a measure for the eradication of the disease. It was merely designed to eliminate the true bovine consumptive, *i.e.*, animals (*a*) suffering from tuberculosis of the udder ; (*b*) giving tuberculous milk ; (*c*) suffering from tuberculous emaciation ; and (*d*) suffering from a chronic cough and showing definite signs of tuberculosis. The owner or person in charge is required under penalty to notify the existence or suspected existence of disease in any bovine. This provision is more honoured by the breach than in the observance. The apathy of many stockowners has stultified the position of the whole agricultural community. It is evident that many stockowners have a deep-rooted antipathy to notify the authorities that they have in their possession an animal suspected of or affected with tuberculosis. They prefer either to dispose of their ne'er-do-wells through the usual channel, or retain them in the herd until detected by the official veterinarian on routine inspection. This lapse from moral rectitude is the result more of want of thought than of evil intent. This non-compliance with the requirements of the Order—whether it be the result of indifference, ignorance, or wilful disregard—means that a potential factor in the spread of the disease is either retained in the herd or consigned to the open market. The Milk and Dairies (Scotland) Act stipulates that " it shall be the duty of the Veterinary Inspector from time to time, and once at least in

every year, to inspect the cattle in every district, and to report to the Local Authority the result of every such inspection."

It is interesting to compare the minimum required by the Milk and Dairies (Scotland) Act with the findings of the Royal Commission on Tuberculosis of 1894. In the Report of the latter it is stated: "A most important point is that the spread of tubercle in the udder goes on with most alarming rapidity. The very absence of any definite sign in the earlier stages is one of the greatest dangers of this condition. The milk of cows with tuberculosis of the udder possesses a virulence which can only be described as extraordinary."

A recent inquiry into the incidence of the bovine type of the *Bac. tuberculosis* in milk consigned to this city for human consumption showed that of 329 samples examined, no fewer than 14.5 per cent. were capable of causing tuberculosis in test animals. The results obtained in this inquiry proves conclusively that the present system of supervision and control is inadequate to protect the people of this city and of this country from contracting bovine tuberculosis from the cow. Indeed, the Ministry of Agriculture frankly admit dissatisfaction with the results obtained by the present enforcement of this Order. In the annual report of the Ministry for the year 1929, it is stated: "It is not to be expected that the full benefit will be obtained from the working of the Order until an organisation has been developed for searching out cases of the disease. Such an organisation would be costly, as it would involve a considerable extension of periodical veterinary inspections of all dairy cows, coupled with the application of the biological test." The necessity of a more intensive veterinary inspection of all dairy cows is recognised by the veterinary advisers of the Ministry of Agriculture, but these officials hesitate to advocate a policy which they believe necessary, simply because its adoption would incur additional expenditure. Vast sums of public money are expended by the Treasury and by local authorities in this effort to mitigate the ravages of bovine tuberculosis. The country is not reaping the full benefit of this expenditure. Surely it is false economy to continue this expenditure year in and year out and obtain no tangible result, when by more vigorous action the end desired can be brought immeasurably nearer.

This Order, if amended and effectively enforced, could prevent in great measure the spread of this disease from animal to animal and from animal to man. The objective must be the detection and removal of all animals before they become the centres of dissemination of the disease. The attainment of this ideal in every instance is, of course, wellnigh impossible, but it is possible to hasten the detection and the removal of many animals before they become centres of dissemination. This could be accomplished by a change in methods of inspection and administration, and it is a debatable question whether or not the expenditure of public money would be materially increased.

Biological examination of 329 samples of milk recently consigned to Glasgow revealed that no less than 14.5 per cent. contained virulent tubercle bacilli, and therefore were capable of transmitting bovine tuberculosis to man. This high

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percentage of infective milk consigned as human food to the city is very disquieting, and common humanity demands that immediate measures be taken to eliminate this pollution from the milk supply. During 1932 no fewer than ninety-four cows slaughtered on behalf of traders were found to be affected with tuberculosis of the udder. It would be an invaluable corollary were it possible to determine the number of human beings infected with bovine tuberculosis through drinking the milk of these ninety-four cows. If the stockowners could but visualise the havoc effected by this disease they would make a speedy end of this scourge.

A veterinary officer of the Ministry is empowered by the Tuberculosis Order to prohibit the importation of an animal which is, or appears to be, suffering from tuberculosis of the udder, indurated udder, or other chronic disease of the udder, or tuberculous emaciation, or giving tuberculous milk, or suffering from a chronic cough and showing definite clinical signs of tuberculosis. Unfortunately, many animals affected with advanced tuberculosis show no definite clinical signs of the disease. The seriousness of the position will be recognised when it is stated that many of these animals are purchased by dairymen as additions to their herds to supply milk for human food. No imported animal capable of being used either for the production of milk or for the purpose of breeding ought to be permitted to leave the landing wharf until it has been tested by an official of the Ministry, and declared by him to be free of any communicable disease.

At a meeting held recently in London, the Council of the Royal Agricultural Society for England, under the Presidency of the Duke of Devonshire, considered a report on bovine tuberculosis, and endorsed the recommendation of the Committee, which was as follows: "That the Tuberculosis Order of 1925 is wholly ineffective as a measure for decreasing the incidence of tuberculosis in the herds of Great Britain, and that the money spent on its operation is wasted. The Council are unanimously of the opinion that as a first and important step towards the eradication of tuberculosis, mastitis, abortion and Johne's disease in cattle it is essential to institute throughout the whole country routine inspection not less than four times a year, and a whole-time staff of veterinary officers. The Council do not consider that pasteurisation, whatever may be its merits or demerits, can be alternative to the above suggestion." We have in this resolution the considered opinion of the most important and influential agricultural society in England that it is necessary to organise a permanent staff of whole-time veterinary officers to inspect every milch cow four times each year. This pronouncement is all the more important as it embraces not only tuberculosis, but abortion, mastitis and Johne's disease. These diseases cause heavy financial losses to the farming community and to the country. Every effort ought, therefore, to be made to minimise these losses.

The National Farmers' Union are also of the belief that the purity of the milk supply can best be attained by the regular inspection of the herds, but they

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express no opinion as to whether or not the inspection ought to be undertaken by the Local Authorities or by the Ministry of Agriculture. This inspection of herds must be considered from the viewpoint of the eradication of the disease and of the purity of the milk supply of the nation. The attainment of these two objectives is only possible if the control is exercised by a central authority.

In my report, dated August 21st, 1928, submitted to and approved of by the Corporation, I suggested that every cow yielding milk for the food of man be examined once a month when housed, and once every two months when at pasture. Further, I suggested that this examination ought to be entrusted to the veterinary practitioner working under the supervision and control of a district veterinary officer, each to be appointed by, and be responsible to, the central authority. The success of any scheme which may be promulgated will depend largely on the attitude assumed by the farming community. Stockowners are not unique in looking askance at what is erroneously described as official interference. It must be admitted that to engender a feeling of hostility would be unfortunate, and it would be advisable to promote and to maintain a close bond of interest between the inspecting authority and the stockowner. To a great extent this desired compatibility does exist between the stockowner and his veterinary adviser. The machinery necessary to carry into effect a more intensive routine inspection of all milch cows is to hand, and after adjustment it is capable not only of searching out all forms of " open " tuberculosis, but of employing the greatest moral force for the eradication of bovine tuberculosis and the effective control of such diseases as contagious abortion, contagious mastitis, and Johne's disease. In the past, the members of the veterinary profession have swept the country clear of many animal plagues. To-day, the veterinary practitioner has eradicated tuberculosis from herds, and there is no reason to believe that he would be less successful were he to be employed by the State.

Our herds are maintained either by breeding or by purchase. It stands to reason that the former must undergo a periodical culling in order to make room for younger animals. The process of culling necessitates taking into consideration many factors, *e.g.*, age, usefulness, health. An animal which the owner suspects is suffering from any disease is invariably included in the lot for disposal. When such an animal is in calf it is sold for the production of milk. In this way many diseases communicable from animal to animal and from animal to man are permitted to be spread from herd to herd. These diseases, which include tuberculosis, contagious abortion, contagious mastitis, and Johne's disease, cause not only injury to man through the medium of milk, but grievous loss to the agricultural community. Agriculturists are perturbed at the spread of these diseases, and are seeking a means of preventing their dissemination. We as a nation loathe control, but when no control means the spread of disease to the injury of others, then measures for preventing the dissemination of these plagues must be enforced without hesitation with a firm hand. The danger of spreading these diseases would be materially

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reduced were the indiscriminate dispersal of stock to be prevented from an infected herd. This could be effected by the issue of an order compelling every stockowner in the event of disposing of stock which might be used for breeding purposes to make a declaration that his herd is free from the specified diseases. The declaration could be rendered more effective by requiring it to be countersigned by the veterinarian making the routine examination of the herd.

The onus of emitting such a declaration would do much to bring home to many stockowners the deplorable condition of their herds, and it would compel them to employ stringent preventive measures. At present they live in a fool's paradise, seeking to minimise their legitimate losses by disposing to their neighbours animals grossly over-valued because of their diseased condition. It must not be assumed that our stockowners are thus engaged in an illicit traffic of diseased animals. There is no law to prohibit this trade, and its continuance must be attributed to the supineness of the Ministry of Agriculture rather than the dishonesty of the stockowner. The latter is merely carrying into effect the human instinct of self-preservation.

It must be admitted that little encouragement has been given to the live stock industry to expend money and energy to maintain healthy herds. Every stockowner must be made to understand that it is his duty to eliminate disease from his herd, and further that the State will give him every assistance in the attainment of this object. Both State and stockowner have each been remiss in their duty to the people of this country. The stockowner has been left to wallow in the mire because the Government authorities have failed to recognise their responsibilities and to grasp their opportunities.

As a result of routine inspection in the City of Glasgow for 1932, the total number of cows which fall to be included under the Tuberculosis Order is 26, or 2.6 per cent.

In the returns for 1931, issued by the Ministry of Agriculture, it is stated that there were in Scotland 454,087 cows and heifers in milk and in calf. By calculation it is shown that the probable number of true bovine consumptives to be some 11,804. As already stated, the number of animals slaughtered during the year 1931 in Scotland under the provisions of the Tuberculosis Order was 3,060, and this subtracted from the estimated number of 11,804 reveals the startling fact that no less than 8,746 bovine consumptives were not detected by the present system of control.

It is certainly not surprising that the Council of the Royal Agricultural Society of England asserts "that the Tuberculosis Order of 1925 is wholly ineffective as a measure for decreasing the incidence of tuberculosis in the herds of Great Britain, and that the money spent on its operation is wasted.'

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Abstracts of Current Literature

Notes on Epidural Anæsthesia. By Dr. Dehecq, *Veterinary Surgeon of Landrecies, Nord. Recueil de Méd. Vét.*, April, 1933.

Epidural anæsthesia, first conceived by the American, Leonard Corning, in 1885, and put into practice in France by Cathelin, who tried it on the dog by the sacrococcygean method in 1901, has recently returned to us from Germany, and seems since then to have enjoyed an ever-increasing vogue amongst our colleagues. Whatever part may be chosen for the injection—the lumbar sacral, the sacrococcygeal, or the intercoccygeal, most writers on this subject agree as to its being perfectly innocuous, and up to the present not one has noted the appearance of troubles which may be attributed to this method of anæsthesia. In the course of the last two years we have been able to execute a certain number of epidural anæsthesias, and if the majority have convinced us of the undoubted interest of the method, there are, nevertheless, some which, apart from any technical error, have left some doubts as to their advisability in certain cases.

Several factors indeed must be taken into account if one is to obtain from epidural anæsthesia all the advantages which they can offer. It must be reserved for circumstances in which it is really useful. What is known of the physiopathology of anæsthesia of the spinal column seems to entail a certain circumspection as regards its therapeutic use.

Leaving on one side the choice, the dose, the preparation of the anæsthetic substance and the technique of the operation, which have been sufficiently detailed by numerous writers, we think, nevertheless, it would serve a useful purpose to stress the fact that there is no anæsthetic which is not toxic, and that certain subjects are particularly sensitive. The liver must be able to fix or neutralise the anæsthetic substance, the kidneys to eliminate it easily; but everybody knows that the state of these organs is, clinically speaking, a deceptively unknown quantity. The same dose, calculated for a definite living weight, will produce, all else being equal, perfect anæsthesia as regards duration and results in the one case, whilst in the case of another animal striking accidents will occur.

Two strong Dutch cows belonging to the same stock, approximately of the same age and the same condition, in the case of both of which manual delivery was necessary, were given by the intercoccygeal method 10 c.c. of syncaine, adrenalised to 2 per cent. In both cases the delivery was effected fairly easily: for one the consequences were normal; for the second the anæsthesia persisted for more than forty-eight hours with staggering, difficulty in rising, tetanic contraction of the left hind fetlock joint, prostration; all the troubles disappeared shortly after the subcutaneous administration of two grammes of caffeine and twenty grammes of uroformine. The general state of the subject is a factor

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which, according to circumstances, must militate for or against the epidural anæsthetic.

Even after the preparatory administration of cardiac tonics and anti-infectives (caffeine, strychnine, uroformine), it seems that it should be avoided in the case of anæmic animals (*i.e.*, animals suffering from fluke, Bang disease, or foot-and-mouth disease). Indeed, although after epidural injections with coloured matter only the outer side of the dura mater is impregnated, there is no proof that the action is the same as for the introduction into the vertebral canal of an inert colouring matter, and for one of the anæsthetic substances usually employed. It is not impossible that this anæsthetic, which is more or less toxic, may not modify by inflammatory reaction penetrating in depth this meningeal barrier, thereby allowing medullary invasion by the pathogenic germs carried by the blood.

The following observation seems to a certain degree to justify the possibility of this hypothesis. A Flemish cow, eight years old, in danger of a miscarriage following on foot-and-mouth disease. General appearance little changed; expulsion of purulent lochia for two or three days, moderate efforts at expulsion noted the same morning, obliterated os (dilatation of about 10 centimetres) : epidural injection of 10 c.c. syncaine adrenalised, 2 per cent. ; manual dilatation without result, repeated warm irrigations up to the evening of the next day ; second epidural injection 15 c.c. adrenalised, 2 per cent. ; efforts at manual os dilatation sufficient to expel a fœtus of about seven months, macerated ; delivery incomplete, malodorous lochia ; consequences apparently normal during the five to six days following delivery, then in rumination, prostration anuria, fœtid diarrhœa, paraplegia, sterno-abdominal decubitus, the head resting on the ground on the lower maxillary ; dorso-lumbar sensitiveness lost ; temperature 39°–39.5°. Internal stimulants and anti-infective treatment ; antiseptic uterine irrigations without effect. Death followed nine days after the first intervention.

Taking into account the share which to all appearances post-partum septicæmia played, it nevertheless seems indubitable that this animal had a meningeal reaction due to the irritating action of two successive epidurals. For the same reasons it may be easily imagined that in the course of certain manual deliveries with irreducible cotyledonary adhesions and rapid alteration of the membranes, it would be necessary not only to renounce all efforts at delivery (as our colleague Léon Dauvois has frequently very wisely advocated), but also to abstain from any spinal anæsthesia.

In dealing with some embryotomies (narrow pelvis, excessive volume of the fœtus), epidural anæsthesia does not always appear to be indicated, for if the expulsive efforts of the patient, certainly very troublesome for the operator, are partly suppressed, the uterus continues to contract, literally clinging to the fœtus, and to the hand of the operator, which, with the relaxation of the soft post-cervical parts, helps to render the work of manipulating the embryo, or the placing in position of the blade of the saw, very difficult. It seems in the emergency that the administration *per os* of a strong dose of alcohol, or the intravenous injection of tincture of opium, would be preferable.

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Finally, in the case of strangulated hernia, the epidural injection must be formally renounced. Under the action of the anæsthetic inhibition of the sympathetic nerve occurs: the intestine, finding itself under pneumo-gastric influence, contracts violently, and may, before anything has been done, cause rupture at the level of the constrictor ring. On the other hand, this possible dissociation by anæsthesia between the medullary and ganglionary centres of the movements of the intestine (Cotte)—the working centre of the reflex being in the marrow—might be turned to account against colics by spasmodic obstruction when the atropine has remained without result, the physiological section of the sympathetic nerve leading to the end of the spasm.

Treatment of a Case of Hæmophilia in the Dog. By Dr. Noel, *Veterinary Surgeon, Tunis Recueil de Méd. Vét.*, June, 1932.

A German shepherd dog was shown to me with a few polypi on the penis. In view of the snappiness of the animal he was anæsthetised. Three average-sized polypi were cut off quite close to the mucosa. Since the operation troublesome hæmorrhage followed. Peroxide of hydrogen, 1 in 3, and perchloride of iron did not give any result. After an hour's use of compresses on the wounds the bleeding apparently stopped, and the dog was put in his corner. The blood, however, kept dripping away in the night, and I was recalled the next day. There were small wounds quite healthy and benign from which the blood escaped, soiling all the parts. I tried antipyrine solution at 5 and 10 per cent. Coagulation was not obtained, and blood flowed from the capillaries and remained liquid on the operating table. An injection of 1 c.c. of fluid extract of ergot of rye was given morning and evening. I saw the animal on the morrow, and it was still bleeding. On account of its weakness and deeply anæmic condition, I prescribed artificial serum injections and cacodylate of soda injections without appreciable results. Emile Weil advising injections of 40 c.c. of serum under the skin to check bleeding in hæmophilic human subjects, I meditated practising this treatment, but was not able to obtain any normal serum; and so I tried, at all risks, two injections, at an interval of one hour, of 10 c.c. of anti-tetanic serum. Results were hardly expected, but the hæmorrhage ceased, and has not returned, and the dog is now in perfect health.

Trichomoniasis in Pigeons. By A. Bos. *Tijd. voor Diergen.*, November 15th, 1932.

The author investigated the localisation of *Trichomonas columbæ* in the organs of pigeons which were suffering from or had died of a disease characterised by the appearance of necrotic foci. He did so by making cultures from these foci, using as medium the Locke egg serum medium of Boeck and Drbolav (1925). The flagellate was encountered in typical foci of liver, pancreas, heart, pericardium, pleura and peritoneum, but it also was seen in foci in lungs, blood vessels (vena cava), and in the wall of the œsophagus and surrounding muscular tissue, even

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in the covering skin. Not only in the tissues were Trichomonas found, but they also occurred in preparations taken from the mouth, throat and crop, and occasionally in the intestine.

Intravenous Injections in the Treatment of Grass Tetany. By H. A. PULLES. *Tijd. voor Diergen.*

THE author has obtained excellent results in the treatment of grass tetany and milk fever by the intravenous injection of the following solution: Calcium chloride, 27 grammes; magnesium chloride, 8 grammes; water, 250 grammes. The injection ought to be practised very slowly. It is stopped if the heart-beats become irregular.

Reviews

The Early History of Veterinary Literature. By MAJOR-GENERAL SIR FREDERICK SMITH, K.C.M.G., C.B., F.R.C.V.S., with a Memoir of the Author by F. W. BULLOCK, LL.D. Vol. IV. Pp. xxiv+162, and 11 photographs. London: Baillière, Tindall & Cox. Price 15*s*.

IT is well for the veterinary profession that its ranks still include, and always have included, men who work willingly for the love of the profession, and not for monetary reward. The whole series of the four volumes for which the late Sir Frederick Smith was responsible was a labour of love and is included in this category, and the subsequent efforts of those who have arranged and presented them in readable form (a by no means light task) come equally in the same category too. The British Veterinary world can never fully repay Dr. Fred. Bullock for the time and energy which he has voluntarily, and without any other reward than the satisfaction "of good work well done," devoted to preserving this and other works of literary merit under Sir Frederick Smith's authorship, solely in order that the future historians of British Veterinary Science may have a solid foundation upon which they can rely.

In the preface Dr. Bullock relates the difficulties (owing to increasing illness and infirmities) under which the author worked during his latter days, and the difficulties which he himself had to collate into book form the somewhat scrappy notes which Sir Frederick had not had time to place in proper order. In some seven exquisitely written pages one reads the best memoir of the great man which has ever appeared in the veterinary (or any other) press. This memoir reveals the combination of greatness and gentleness which was so characteristic of Sir Frederick Smith, right from the days when he was a humble lieutenant to the triumphant day on which he was promoted to the highest position the Army can confer on a British veterinary officer. His character is summarised in the concluding paragraph, where Dr. Bullock writes: "He was devoted heart and soul to his profession, and jealous for its reputation. All his talents were spent in its service, and in the last few years of his life he made greater and greater efforts to save money to invest in order that he might, after providing an income for his family for their lives, leave as a reversionary gift to the profession as large a sum as possible for the purpose of establishing a fund for the promotion of veterinary research"; and, after alluding to the list of General Smith's contributions to veterinary literature, he concludes with a paragraph which every

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member of the profession will earnestly endorse. " Truly he was a man of whom the profession should be proud, and whose memory it should revere."

In the history years of which this volume deals, Smith's patient search includes the name of every veterinary writer from that of J. T. Hodgson, who qualified in 1814 (having served as a civil veterinary assistant in the Corunna campaign), and was the first veterinary surgeon to be appointed to the Indian Army (1826), to those " grand old men " of the profession—Joseph and John Gamgee (father and son), whose writings advanced the veterinary art so much in the nineteenth century.

To select any for special mention would be invidious. It is a book that every lover of the veterinary profession should buy—not only to recognise and derive encouragement from the enormous difficulties these pioneers strove to overcome, but in gratitude to the compiler (Dr. Bullock) for the enormous amount of voluntary work well done, and to the publishers (Messrs. Baillière, Tindall & Cox), whose part is " well played " too. It is a further token of their unswerving loyalty to a profession whose actual commercial outlet must always be of necessity small and comparatively unremunerative.

A Pocket Medical Dictionary. By Lois Oakes, S.N.R., and Thos. Davie, M.D. Liverp. Pp. 350. Edinburgh : E. & S. Livingstone. Price 3*s*.

This little brochure does not pretend to be a complete medical dictionary, but aims at including enough details, briefly described, of medical terms likely to be in everyday use (and therefore of everyday service) in conversation between the medical practitioner and the student or the qualified nurse. As such it probably may fulfil a useful purpose, although, as will readily be understood from its size, its sphere will not reach much further ; and some of the descriptions given are of necessity somewhat brief. As the author says in the preface : " the book makes no claim to the completeness of the larger dictionaries," and in a further paragraph, " it is therefore my hope that it will prove of real service as a means of quick reference for the busy medical student." This is quite palpably the chief object for which it is written.

Cattle Farming in South Africa. By A. M. Bosman. South African Agricultural Series. Vol. 10. Pp. 458. Pl. 36. Central News Agency, Ltd., South Africa. Price 27*s*. 6*d*.

This is a text-book for students and a practical reference work for all interested in the cattle industry of South Africa—a country which has many problems peculiarly its own, and in which, therefore, it is not possible to utilize standard books of other countries without far-reaching qualifications. Part I deals with the cattle industry, with special reference to the beef industry and to the dairy industry. Part II with the principles of breeding. Part III with feeds and feeding, computation of rations, and selection of economical feeds. Part IV with the care and management of cattle, with veld management, ranching and intensive pasture management. Part V is miscellaneous, devoting a special chapter to the Africander breed, another to the trek or draught type, a third to preparing cattle for the show, and a fourth to the production and handling of milk and cream. The book thus covers much conventional ground, but the special requirements of South African conditions, technical, economic and social, are always kept in view, and much original matter is incorporated, derived from the author's personal experience as Professor of Animal Husbandry in Pretoria University. The author stresses his faith in the South African pastoral industries, and urges the Government and farmers to recognise the need for their development.

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News

ENGLISH DOCTORS OF VETERINARY SCIENCE, UNIVERSITY OF ZURICH.

Honorary Doctor (proclaimed at the Centenary of the Zürich University, April 29th, 1933) : Professor Sir FREDERICK HOBDAY, Principal and Dean, Royal Veterinary College, London. For his merits on the field of veterinary surgery, and for the advancement of veterinary science in England. The veterinary faculty of Zürich highly appreciates the activity of Sir Frederick in veterinary surgery, and his publications on this line. The faculty admires also the perpetual and keen activity of Professor Hobday on behalf of the development of the Royal Veterinary College, London, which will be of high importance for the progress of veterinary science in England, and in the entire British Empire.

Other English doctors of the Zürich Veterinary Faculty : STANLEY H. WHITWORTH, M.R.C.V.S., wrote a thesis on " The Influence of Hydrogen-ion Concentration on the Biology of the Anthrax Organism " (1922), after having made a long series of exact experiments in the Veterinary Pathological Institute, Zürich. The thesis contains, after a general explanation of the importance of the hydrogen-ions for biological processes, investigations on the H-concentration on the growth of the anthrax organism, further, on the variability and adaptability of the bacillus to grow in media of a relatively high H-concentration, on the production of acid by the bacillus, and finally on the influence of pH on the heat resistance of anthrax spores at different temperatures. The temperature resistance of the microbe decreases considerably with the decrease of pH, that means with increasing acidity.

HEDLEY C. D. GOLLEDGE, F.R.C.V.S., Yeovil, Somerset, England, made (1931) investigations on the reductant power of tissue of infected animals in the Veterinary Pathological Institute, Zürich. These experiments form a part of a long series of investigations on anaerobiosis going on in the Institute. It had to be found whether there exists a difference in the reductant power of the tissue of animals infected with blackleg micro-organism compared with fowl cholera or tuberculosis or normal animals. The difference is greater between normal and blackleg than between normal and fowl cholera or tuberculosis.

WILLIAM M. SCOTT, F.R.C.V.S., Friarn House, Bridgwater, author of " Clinical Bacteriology and Vaccine Therapy for Veterinary Surgeons " (1913), and of " An Indexed System of Treatment " (1924), collaborator with E. Wallis Hoare in " System of Veterinary Medicine " and " Veterinary Therapeutics," presented a thesis " A Contribution to Actinomycosis, with Special Reference to Vaccination " (1932), which contains the experiences of his long professional career. He proved the possibility of successful vaccine treatment by the description of the full history of 143 cases. One hundred and eighteen cases were complete recoveries, twelve cases partial recoveries, and thirteen cases were failures.

JAMES WALKER, O.B.E., M.R.C.V.S., late Director of the Veterinary Bacteriological Institute, Kabete, Kenya Colony, presented (1933) a thesis which is a full description of East African swine fever, containing the results and experiences of numerous experiments carried through in the last fourteen years. The thesis—being printed very soon—will bring a description on the nature of the virus and the possibility of immunisation and control of the disease by artificial immunisation. It is a monograph of all our present knowledge on East African swine fever, and the keystone of Dr. Walker's scientific career. Dr. Walker is certainly the best expert on this disease, which in certain points differs from the ordinary European or American hog cholera.

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RESEARCH DEFENCE SOCIETY.

At the annual general meeting of the Research Defence Society, to be held at the London School of Tropical Medicine, Keppel Street, London, W.C., on Thursday, June 22nd, at 3 p.m., the Chair will be taken by the President, Lord Lamington, supported by Sir Arthur Stanley, chairman of committee. The seventh Stephen Paget Memorial Lecture will be delivered by Sir Leonard Rogers, F.R.S., on " The Saving in Life and Suffering due to Medical and Veterinary Research, with Special Reference to the Tropics." The lecture will be illustrated by lantern slides. Tea will be served after the lecture, and visitors (especially veterinary surgeons and medical men) are invited.

Correspondence

THE LATE PROFESSOR SIMONDS AND A PECULIAR FIND OF HORSE SKULLS.

To the Editor of THE VETERINARY JOURNAL.

SIR,—I am immensely interested in the extract you sent me relating to Professor Simonds, and thank you very much for it, and also for the copy of your VETERINARY JOURNAL. I have been for years collecting records of Bungay, and have searched through my papers for the name of Simonds. I find Samuel Simonds, mentioned as a blacksmith or farrier in 1787 to 1797, and in 1826 his name occurs as horse dealer also. At this time he was renting a house at £10 per annum, where, I have not at present discovered. He was liable to take an apprentice. Also I note in the old directories are the headings in the trades lists of " Blacksmith and Veterinary Surgeons," and in some cases " Veterinary Surgeons and Forge." From this I conclude the two businesses were combined. Yesterday I found which house and premises were occupied by your old professor, and our veterinary here is making inquiries, and may be able in a few days to tell me more about him and his movements while in Bungay. I do not think he ever lived in the house where the skulls were found. If I could only date the heads it would be easier to come to some conclusion about them, I think.

Yours truly,

Earsham Street, Bungay, Suffolk.
May 28th, 1933.

ETHEL MANN.

EXTRACTS FROM DICTIONARY OF NATIONAL BIOGRAPHY.*

SECOND SUPPLEMENT, VOL. III.

SIMONDS, JAMES BEART (1810–1904), veterinary surgeon, born at Lowestoft, Suffolk, on 18 Feb., 1810, was son of James Simonds (d. Oct., 1810) by his wife, a daughter of Robert Beart, of Rickenhall, Suffolk, an agriculturist and horse-breeder. The father was grandson of James Simonds (born in 1717), who early left the original family home at Redenhall, Norfolk, for Halesworth, Suffolk. Of his five sons born there, Samuel (born in 1754), the fourth, who resided at Bungay in Suffolk, had four sons, the eldest (Samuel) and youngest (John) entering the profession; the second son, James, was father of the subject of this notice.

James Beart, brought up by his grandparents at Bungay, was educated at the Bungay Grammar School, and entered the Veterinary College in London as a student

*Edited by Mr. Chas. Walter Berry (brother to the late Mr. Arthur Holman Berry, F.R.C.V.S., Superintending Veterinary Inspector to the Ministry of Agriculture and Fisheries).

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on 7 January, 1828. He received his diploma to practise in March, 1829, and succeeded to his uncle Samuel's business as a veterinary surgeon at Bungay. In 1836 he migrated to Twickenham, and shortly after took a share in organising the scientific work connected with the animals of the farm of the then newly-established English Agricultural Society, of which he became an ordinary member on 25 July, 1838 (honorary member, 3 April, 1849; foundation life governor, 5 March, 1890). In 1842 he was appointed to a new professorship of cattle pathology at the Veterinary College in Camden Town, and was made consulting veterinary surgeon to the Royal Agricultural Society (a position he held for sixty-two years until his death). Settling in London, and disposing of his practice at Twickenham, he was active in the movement for obtaining the charter which was granted on 8 March, 1844, to the Royal College of Veterinary Surgeons, of which in due course (1862–3), he became president. He took a prominent part in the efforts of the Royal Agricultural Society to popularise information amongst farmers as to the diseases of animals, and he investigated their causes and means of prevention. In 1857 he carried out an inquiry on the Continent into the Cattle Plague, which was then committing great ravages, and made a report of eighty-three pages thereon. His information proved useful on a sudden outbreak of the disease in London in June, 1865. The Privy Council office, owing to doubt of its legal powers, delayed the issue of an order for the slaughtering and burial in quicklime of all diseased animals until the infection had spread over a great part of England. A Veterinary Department was improvised at the Privy Council office to deal with the matter. Simonds was appointed chief inspector and professional adviser, and amongst his helpers was Professor (afterwards Sir) George Thomas Brown (*q.v.*, Suppl. II). After the stamping out of the outbreak of cattle plague, which was estimated to have cost five millions sterling in money loss alone, it was decided to continue the veterinary department as a permanent branch of the Privy Council office, and Simonds remained at its head until November, 1871, when he resigned in order to become Principal of the Royal Veterinary College in succession to Professor Charles Spooner (*q.v.*). Owing to failing health, he retired in June, 1881, on a pension, removing to the Isle of Wight. He remained senior consulting veterinary surgeon to the Royal Agricultural Society until his death, at the age of ninety-four, on 5 July, 1904.

He was twice married, his first wife being his cousin, Martha Beart (d., 22 Aug., 1851), by whom he was father of James Sexton Simonds, for some time chief of the Metropolitan fire brigade, and of two daughters. His second wife survived him.

(Autobiography, reprinted with portrait from *The Veterinarian*, Vol. LXVII (1894), and privately issued in 1894; *Veterinary Record*, 9 July, 1904; personal knowledge.)—E.C.

Publishers' Notices

All communications should be addressed to 7 & 8, Henrietta Street, Covent Garden, London, W.C. 2. Telephone: Temple Bar 4646. Telegrams: "Baillière Phone, London."

Letters for the JOURNAL, literary contributions, reports, notices, books for review, exchanges, new instruments or materials, and all matter for publication (except advertisements) should be addressed to the Editor.

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